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The Welding Engineer

AUGUST, 1943

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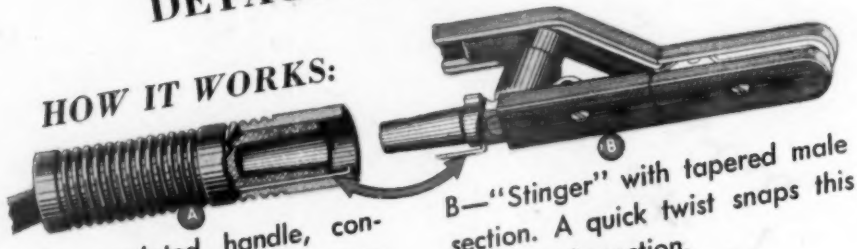
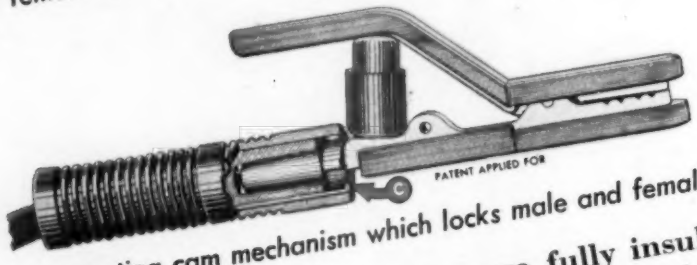


A—Insulated handle, containing female cable connector.

B—"Stinger" with tapered male section. A quick twist snaps this into female section.



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The Welding Engineer

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The Welding Engineer

AMERICA'S PIONEER WELDING JOURNAL

Established 1916

Vigilance Is the Price

Pay checks for most of us have been somewhat slimmer this past month. Nearly everyone in the country is beginning to feel that he has now received a 20% reduction in salary. Some people have in reality begun to pay income taxes for the first time. To others, it meant that they were passing from a cash to an installment plan of paying these taxes.

Even though the pay check is short, however, don't relax on buying War Bonds. Income taxes must be paid under any circumstances, so the deductions which place payment on a weekly basis should bother only tax-dodgers—not honest citizens.

We are all willing to pay our share of the war's enormous expense, but we do not want to go on paying long after the war ends to support a war-swollen bureaucracy performing but few indispensable functions. The great danger of this "pay cut" system of taxation is the public's short memory. Despite the fact that everyone of us is now contributing weekly to the operating expense of the Government, many people, we predict, will soon forget about their contributions and a major portion of our taxes will be collected in the form of hidden taxes.

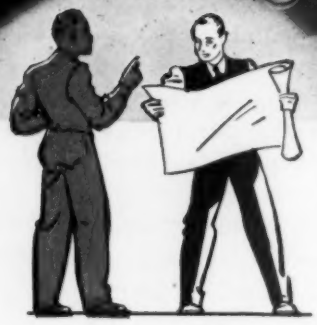
Watch out for this complacency! There is danger in the superficial thought: "A person never misses something he never has."

Don't forget the country is now committing itself to a huge public debt which, it has been estimated, will take an average of 25% of the earnings of every worker for the rest of his life. The war has made this inevitable. Though we have lost a part of what might be called our financial freedom, however, we still have political freedom.

How long and how well we keep our political freedom will depend solely upon us as citizens. If we permit the Government to absorb private industry, the foundation of political freedom will then be lost. For the ordinary citizen, there can be no real independent economy without continued private ownership under a free competitive system.

Every individual must do his part—in letters to Congressmen, if necessary—to see that industry remains substantially free of Government domination. The individual must also be alert to see that the Government pursues a policy of taxation and regulation which will encourage and not discourage private employment.

Although the conditions brought about by the war have shackled our purses, we must not allow our political freedom to be shackled, too. Eternal vigilance is the price of liberty!



then I said to myself—

Here's How to Reach That Post-war Market Quick

So you want to get the jump on competition — **get to that post-war market first with the most sales features?** *Then take a tip from the Army's amphibious truck—the "duck".*

Well, it is a versatile vehicle—carries troops or cargo across water or land—doesn't even stop in going from one to the other. Say, if only I could do likewise—drive straight ahead without a stop and with all our people aboard—in going from war products to peacetime products.

Then, hop aboard the vehicle used by builders of the "duck", the Liberty ships, the M-4 tanks, the bombers and fighters, and hundreds of other war products. They went from peacetime products to war equipment almost overnight. Their vehicle is WELDING.

Sounds logical. Welding does simplify design . . . quickens tooling up . . . speeds production . . . makes selling easier because it makes products better and cheaper.

And one more suggestion. Learn how to drive this V-day vehicle fast and straight with Lincoln's aid on welded design and procedure. Start NOW.

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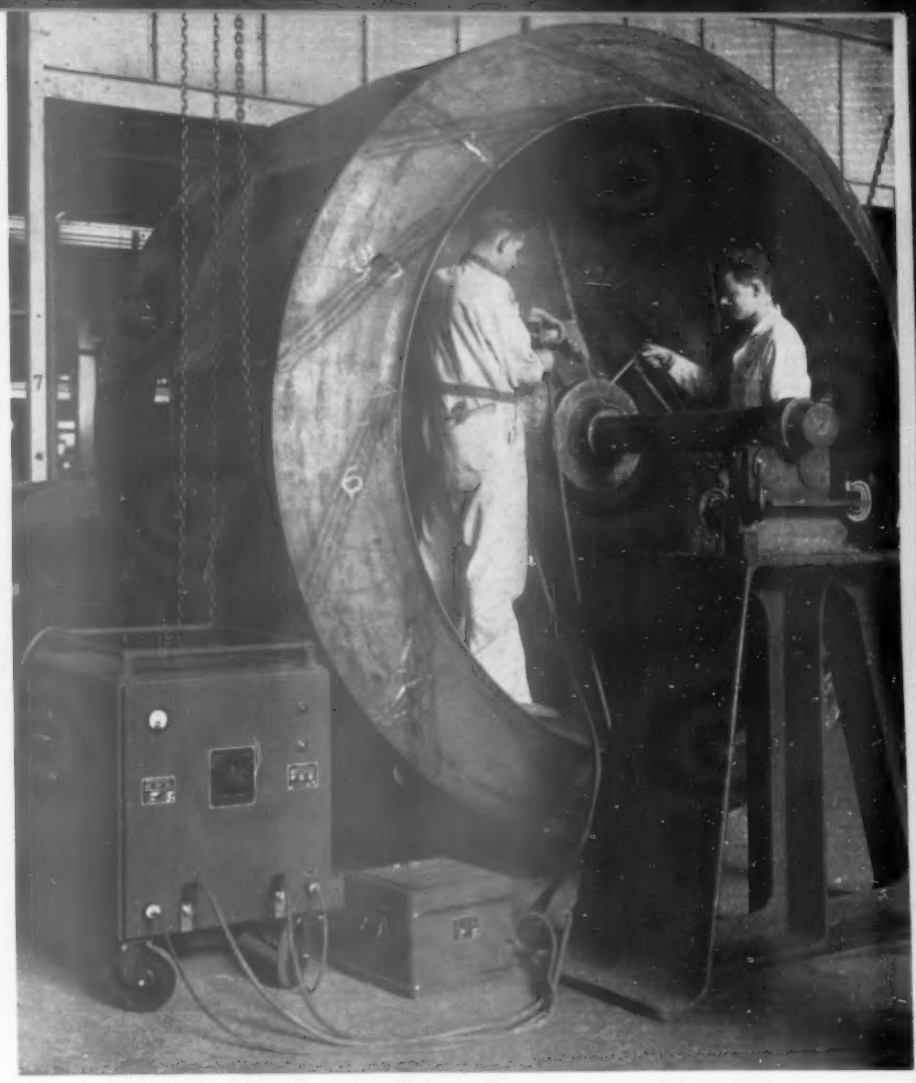


Circular magnetism was used in the magnetic inspection of a huge blower for the Moffat tunnel. The magnetic testing power unit and powder blower for use in weld inspection is shown in the left foreground.

Magnetic Inspection of Welds

Continually seeking to improve armament production, industry is turning to tests that will give a quick check-up on weld quality without harming the product being tested. The advantages and limitations of magnetic particle inspection are discussed in this article—No. 3 in a series on non-destructive tests.

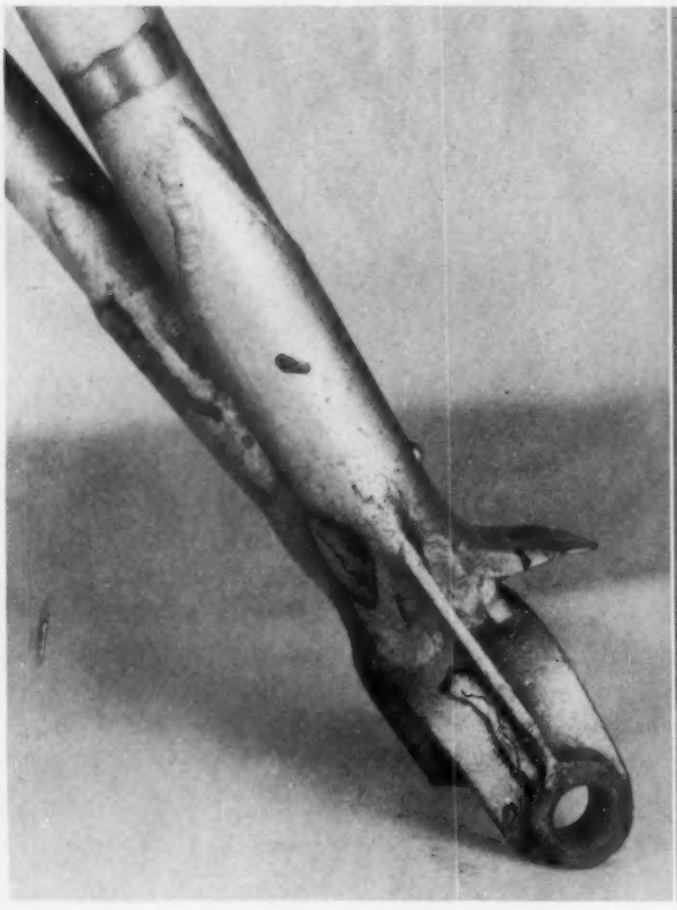
By **T. B. JEFFERSON**

IN THIS period of war production, it is essential that our fighting forces be furnished with the best available equipment in the shortest possible time. To meet the dual requirements of speed and quality, many items of armament have been partly or wholly redesigned. Frequently, the new designs call for welding as a means of joining metals.

Many contractors are not entirely familiar with the welding methods involved because the building of armament is entirely different from their regular peacetime pursuits. New employees lacking in welding experience have to be called upon to perform exacting jobs. Yet the present day demands of the Army and Navy make it extremely important to maintain quality because the finished products have to be able to withstand the rigorous service of War. For all these reasons, there has arisen the need for a practicable means of controlling the welding employed in wartime production.

Destructive vs Non-Destructive

The fundamental requirements for such a control are two: it must serve to reveal weld defects and it must also offer guidance for the establishment of correct welding procedures and techniques. Both of these objectives can be accomplished by either de-



Official photo, Army Air Force

Magnetic inspection of this aircraft strut indicated two defects: one a forging check, the other lack of fusion in the weld.

Official photo, Army Air Force

A weld surface crack which is hardly visible to the naked eye shows up plainly under magnetic inspection.

structive tests or non-destructive inspection methods.

Destructive tests such as tensile, compressive, nick-bend, fatigue, impact, etc. have long been used to determine the quality of welds. In all of these methods, a sample or coupon is cut from the weld being tested or a sample weld is made under the specified procedure. Such tests have their uses, of course, but the method as a whole never gave complete satisfaction—primarily because it is basically illogical to destroy a piece in order to determine that it is satisfactory and approve untested pieces without any real knowledge as to whether or not their composition was the same as that of the tested specimens.

For many years, metallurgists and metallurgical engineers sought a means of quality control that would not involve the destruction of what they were testing. Their search was rewarded by not one but three such methods; namely, X-rays, gamma rays and magnetic particles. Now that the increased tempo of war production is leading more and more manufacturers from destructive to non-destructive tests, all three of these methods have become of vital importance.

Previous articles in THE WELDING ENGINEER discussed inspection by means of X-rays* and by gamma rays†. These two methods, though differing in the type of rays employed, are similar in that the defects are located and recorded on sensitive film, which is then studied, together with destructive tests specimens, as a basis of interpretation for acceptance or rejection of the weld. Instead of a film, the third method uses ferrous powders, which are acted upon by a magnetic field, to give patterns indicating defects on the surface of the part being inspected. Though offering a less permanent record and less penetration of the subsurface structure, this method has many advantages.

Basic Principles

For all practical purposes, magnetic inspection may be likened to the use of a magnifying glass. Instead of using a glass, however, a magnetic field and ferromagnetic powders are employed. The method of magnetic particle inspection is based upon two principles: *one,* that a magnetic field is produced in a piece of metal when an electric current is flowed through or around it; *two,* that minute poles are set up on the surface of the metal wherever this magnetic field is broken or distorted.

When ferromagnetic particles are brought into the vicinity of a magnetized part, they are strongely attracted by these poles and are held more firmly to them than to the rest of the surface of the part, thereby forming a visible indication.

Non-Magnetic Metals

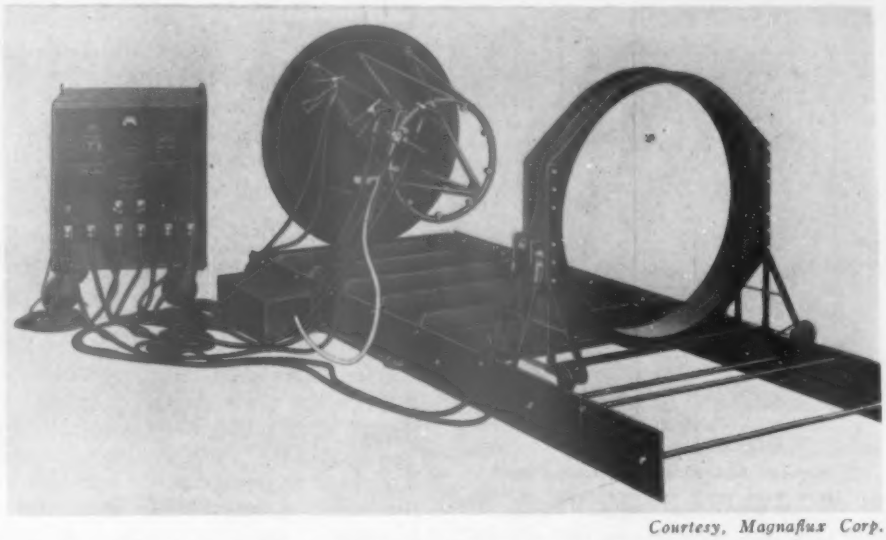
This method of inspection has limitations, the major one being that it is suitable only for use on magnetic material. This includes most ferrous materials but not, unfortunately, austenitic stainless steels. There are also limitations as to the type of defects which may be indicated. The reason for this limitation is based on principle two mentioned above; namely, that local poles are developed where

*"X-Ray Testing of Welds," THE WELDING ENGINEER, August, 1942.

†"Gamma-Ray Testing of Welds," THE WELDING ENGINEER, September, 1942.

the magnetic field is broken. Subsurface porosity, as found in castings, tends to have a spherical contour in cross-section. Because of this contour, the magnetic field flows around the void rather than being broken by it. However, porosity which is more clearly notch-shaped in cross-sectional contour lends itself to detection by magnetic particle inspection.

On the credit side of the ledger, however, magnetic testing is ideally suited for locating the defects most commonly encountered in welding applications; *i.e.*, those defects which are inherent to steel, including nonmagnetic segregations, laminations, etc., manufacturing defects such as slag inclusions, shrinkage, grinding or forging cracks, and fatigue and strain cracks.



Courtesy, Magnaflux Corp.

Aircraft engine mounts must be demagnetized after inspection because of their nearness to the compass. For this purpose, there has been constructed a special unit incorporating a demagnetizing coil which may be slowly withdrawn from the engine mount as it is rotated on a turntable.

Quality Control

Both the Army and Navy, and particularly the Army Air Force, are making use of magnetic particle inspection, not so much for the purpose of rejecting articles containing defects as for the purpose of discovering the detrimental defects which should be eliminated in subsequently produced articles. Thus the application is for quality control rather than for ordinary inspection purposes.

This process is used not only as a basis for rejecting defective parts in the finished condition but also as a guide in eliminating the faulty practices which cause these defects at various points in the production processes. Each type of defect forms a pattern following broad characteristics so that it is possible in most cases to interpret the cause of the indication. For example, seams in bar stock or tubing tend to be very straight and run parallel to the longitudinal axis of the finished part. If it is not possible to interpret the cause of the indication by its appearance, the inspection method may be applied after various manufacturing steps until the one causing the defect is located. Even after the faulty practice has been corrected, many plants use magnetic particle inspection as a spot check on their steps of production to be sure that no trouble is being caused at any one step.

The main purpose of magnetic inspection, as it is being used today, is to set up a boundary line between those articles which are satisfactory and those which are unsatisfactory for use. The determination of those boundary lines must be based upon engineering and laboratory research to determine whether an indication of a certain type in a certain location will cause failure of a part in service. Disposition of questionable parts should include sectioning and etching, stress analysis and actual test runs or physical breakdown tests. If production is high on a given part, it is often advisable for the company manufacturing or fabricating the part to write its own specifications as to what magnetic particle indications are acceptable and what are rejectable on the basis of its tests. By its very nature, this method is sensitive and will show indications which are not detrimental to the use of the part. Care should be exercised so that parts showing indications are not rejected merely for this reason. The cause of the indication and its effect on the performance of the part should be thoroughly analyzed before final acceptance or rejection is made.

Gray magnetic particles on this fillet indicate a surface weld defect.

Courtesy, Magnaflux Corp.

Methods of Classification

The parts to be inspected may be magnetized in any one of several ways. Consequently, there are several bases of classifying magnetizing methods. One classification may be made on the basis of magnetic force—whether it is "on" or "off" during inspection. In this case, the breakdown is made between (1) residual magnetism and (2) continual magnetism.

The residual method, suitable only for materials with high magnetic retentive values, relies entirely upon the amount of magnetism which remains in a specimen following the application and subsequent withdrawal of a magnetic field or magnetizing current. In the continuous method, the magnetizing is conducted simultaneously with the application of the magnetic inspection medium. Since the continuous method is more sensitive and is quite suited to low carbon steels, it is usually preferred for the

Official photo, Army Air Force

Magnetic inspection discovered a crack in a weld which attaches a lug to an engine mount ring. Constant vibration under operation might have resulted in a serious failure if this defect had not been discovered by non-destructive testing.

inspection of welds. This method is suitable for use with all magnetic materials.

Another classification may be made upon the basis of the characteristics of the magnetic field utilized for the magnetizing operation. In this classification there are three fields: (1) circular field, (2) longitudinal field and (3) a combination, sometimes called a vector field. The type of field used is determined by the direction in which the defect to be located lies. In order to produce a magnetic particle indication, it is necessary for the magnetic field to be broken. If the field runs parallel to the defect, it will not be broken by it and no indication will be developed.

A magnetic field is produced at right angles to the direction of the flow of current. Thus a circular field, developed by passing current directly through the part, will show up a longitudinal discontinuity. A longitudinal field is induced by sending current around the part in a solenoid or coil. In this case the field runs from one end of the piece to the other. The longitudinal field is used in locating transverse discontinuities.

A vector field is one which does not run parallel to the longitudinal axis nor circumferentially around the part but is developed at an angle. This is sometimes used on pieces through which current has been passed and in which a longitudinal field is superimposed by a solenoid. The vector field method does not receive widespread use for inspection relative to welding.

Another means for classifying magnetic inspection is on the basis of the type of electric current used. Both direct current and alternating current may be used for magnetization. Direct current produces a field which penetrates below the surface of the metal. The Army Air Force specifications permit only the D-C method. The field produced by alternating current follows only the surface of the metal and hence cannot be used for the detection of subsurface defects.

Power Sources

The most satisfactory results are obtained from special equipment which has been developed for use in magnetic particle inspection. The machine most commonly used in weld inspection incorporates a feature which allows magnetization with as much as 1,000 amp at 6 or 7 volts. This high amperage is not available in the most common D-C generators. However, there are other sources which may be used.

Practically any electrical means which will provide low voltage, high amperage energy will provide a satisfactory source, but many sources are often difficult to adapt to applications. The most readily available piece of equipment is, of course, the D-C welding generator; with this, however, there will be control difficulties. Another drawback to an arc welder is that most of those in common use have a maximum output of 300 amp—too low in most cases to furnish the necessary current intensity for circular magnetism. With a few turns of No. 00 or heavier extra flexible cable, however, 1,200 or more ampere-turns can be obtained for longitudinal magnetism, and this is sufficient to magnetize even parts of a considerable size.

The arc welding generator has also a relatively high open circuit voltage, which is apt to cause burned spots in the contact areas when used for circular magnetism, particularly if there is any movement of the contactors while the current is on. A burned spot is a surface defect, and, since fatigue failures always start with surface defects, it might be sufficient cause for rejection in many cases. For this reason, generators of the plating type, which furnish current at a low voltage, are usually preferred where a D-C motor-generator set must be used. Equipment of this type (which might be described as "makeshift") is not suitable for use in Army Air Force inspections.

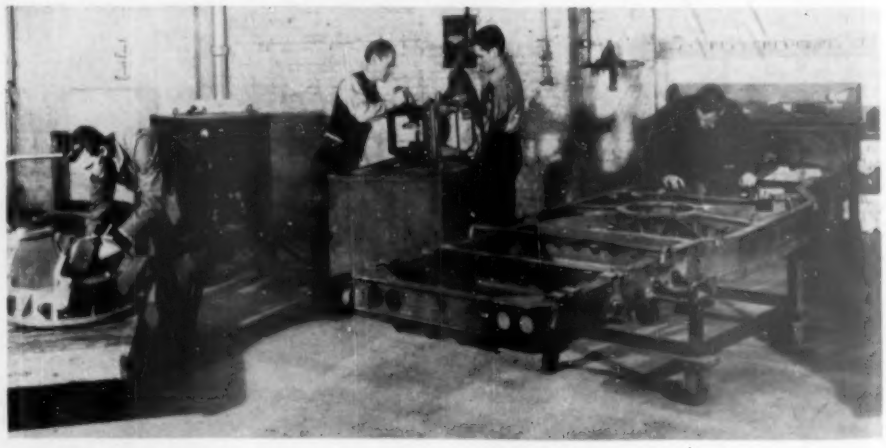
D-C at Line Voltages

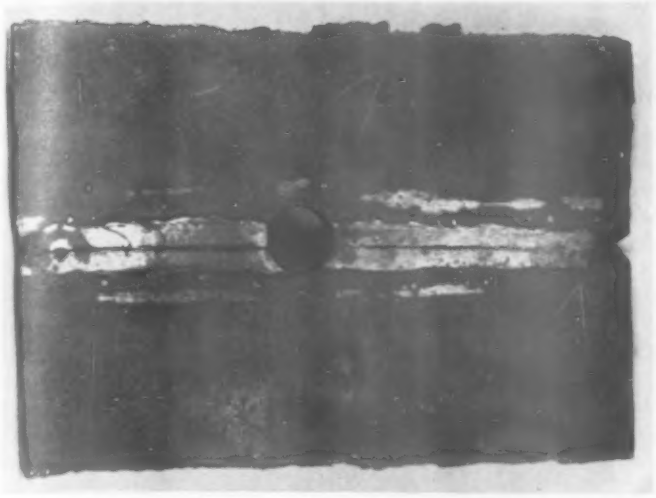
The sources of power for magnetic inspection include D-C at line voltage. If the incoming line supplies direct current at 110, 220 or 440 volts, magnetic yokes or electromagnets for longitudinal magnetization can easily be wound for any of these voltages. The current then becomes a convenient source of energy for longitudinal magnetism. It is practically impossible to obtain lower voltages, however, without going to the expense of purchasing a motor-generator set.

The use of direct current at line voltages oftentimes requires a prohibitive amount of power, and it is, moreover, extremely hazardous from the operator's standpoint. In many cases, these difficulties have been surmounted by the use of storage batteries which will furnish extremely high currents at low voltages for a brief interval of time. The 6 volt automobile battery is most frequently used. Much better results are possible, however, with a battery that has been especially designed for the heavy requirements of magnetic inspection. For this service, the battery should be designed and built for high charge, high discharge and have thin rubber separators. Storage batteries of this type are usually charged by a rectified single phase alternating current at line frequences.

D-C power may also be obtained by stepping down incoming line voltages. Without the use of expensive motor-generator sets, however, direct cur-

A typical industrial set-up for magnetic inspection of welded products.





Excellent results may be obtained in magnetic inspection of welds if the weld bead is ground smooth and black powder used. Note that lack of fusion is indicated for this weld. The diagnosis is verified by the trepanned hole.

Courtesy, Magnaflux Corp.

Table I. Recommended Spacings and Currents

Material Thickness or Size of Weld, In.	Amperes	Electrode Spacing, In.
½ to 1	300 to 350	7 to 8
1 to 3	350 ± 25	6 to 7
3 to 5	350 ± 25	5 to 6
5 and up	350 ± 25	5

rent cannot be stepped down to obtain the high amperage, low voltage usually necessary for circular magnetism.

A more satisfactory means of obtaining direct current for magnetic inspection is by the rectification of three phase alternating current. A-C of any commercial frequency may be used, and the load is distributed over three phases.

If it is so desired (for other than Army Air Force examinations), alternating current may be used as the source. This type of current for magnetization has the advantage of being convenient for the simple reason that most of our power is transmitted by alternating current. Alternating current is available, therefore, in most industrial localities. It must be borne in mind, however, that the use of alternating current will show only surface defects and that the power taken from the line must be transformed into low voltage, high amperage current.

Inspection Mediums

Though iron filings may be used as an inspection medium, more satisfactory results can be obtained from a patented powder especially prepared for magnetic inspection. This powder is made from ground magnetic iron which has a low magnetic-retentive value. The iron is prepared in such a manner that the particles have an elongated shape and are fine enough to pass through a 100 to 300 mesh screen. This material is colored with a powder which also possesses certain lubricating or slippant qualities.

Colored magnetic powders may be obtained in either red, gray or black. All of these powders have the same magnetic qualities, the color being different only to give contrast to the color of the material being inspected. Red stands out well, especially against a sand blasted background. Gray powder is equally satisfactory when sprinkled against the surface of dark (as heat-treated) parts or parts painted with a blue layout dye. Black powder is generally used on bright machine-finished surfaces.

For the inspection of heavy forgings, castings, welds, etc., dry powder is usually used, and applied by means of a salt shaker, a bulb-type duster or a small mechanical blower. For inspection of machined parts or aircraft weld assemblies meeting Army, Navy specification AN-QQ-M-181A, a wet or liquid inspection medium is preferred. In this case, the parts are washed with a liquid. To get an undistorted indication, apply liquid and magnetize immediately on stoppage of liquid flow. This method permits particles to pack-up where required. The wet inspection medium is prepared by mixing 1½ to 2 oz of specially prepared patented paste per gallon of a highly refined kerosene distillate. The wet method is particularly adapted to production inspection of parts small enough to be handled easily. Paste for this method may be purchased in black or red color, whichever gives the best contrast to the work being inspected.

The magnetic particles in another type of paste for use in the wet method of inspection are coated with a highly fluorescent dye. The particles have the same magnetic qualities as other magnetic-particle paste but have the added advantage of giving a bright yellow fluorescent indication when exposed to ultra-violet light. This medium is particularly adapted to inspection of dark surfaces (rough forgings and heat-treated parts) and for the inspection of the ID of hollow parts such as drawing dies.

Despite the many methods for magnetic inspection, there are only a few combinations which are ideally suited to the inspection of welds. D-C sources are the most widely used for production of the magnetic fields since they afford the deepest possible penetration—a condition essential for weld inspection.

Continuous current flow is always preferred for weld inspection since it provides the most sensitive results. For the magnetic field set-up, it is best to employ the circular method wherever practicable. The longitudinal method causes an undesirable magnetic leakage around the end of the field. Irrespective of the method used, however, certain precautions should be taken. Often a method which will work effectively when the crack is at right angles to the magnetic field will not be effective where the crack is parallel to the magnetic field and the flux is not required to cross it. For this reason, some parts require inspection by both longitudinal and circular fields.

Prods and Leeches

The most desirable means for introducing a circular magnetic field into an article to be inspected is by means of a pair of contactors or "prods." These prods are heavy copper contactors which are held in place either by the hand or by small electromagnets—"leeches." The leech provides a convenient means for magnetically attaching the contactors to the structure to be inspected, and power for both the hold-down magnets and the high amperage inspection current can be supplied from a portable power unit. Leeches are not practicable, however, on irregularly shaped parts; on these, the current is usually led into the metal surface through heavy copper contactors that are firmly held by the hand against the structure. One contactor is placed on each side of the weld, and along it, and they are usually spaced from 3 to 6 in. apart, depending upon the current available and the thickness of the metal. Table I gives the recommended spacings and current requirements for various thicknesses of metals and weld sizes.

When the contactors are placed on each side of a weld, the direction of current flow is parallel to the weld and produces a straight magnetic field across the weld. Again, it is well to advise that care should be taken to

prevent arcing or burning at the contact points. On finished work, and particularly where fatigue stresses are expected, contact burns must be avoided or should be ground out if they do occur. To avoid contact burns, it is recommended that the current be shut off without forming an arc at the contacts. Some form of circuit breaker is necessary to accomplish this.

Magnetic Inspection

By the use of magnetic currents and ferromagnetic powders, a break in the surface of ferrous material, invisible to the naked eye may be revealed plainly. Such a break causes a field of force to appear outside the surface, and when the ferromagnetic powders are applied, the particles will collect at this point.

In the inspection of weld defects by ferromagnetic powders, it is possible to detect surface cracks including shrinkage checks and cracks, crater cracks, lack of fusion, undercut and overlap. (These last two, however, may be determined by visual inspection.)

With limitations, certain types of subsurface cracks may also be found. The most common of these are cracks originating at but extending below the surface, including linear porosity and lack of penetration. The magnetic method will also reveal fine cracks when they reach to the surface and large cavities existing at a short distance below the surface. For example, a ⅛ in. cavity ⅛ in. below the surface or a ¼ in. cavity ¼ in. below the surface will be detected.

A reasonably clean smooth surface facilitates the arrangement of the magnetic particles and is necessary for maximum sensitivity. Rough welds tend to hold the particles against the influence of the magnetic field. Chisel marks and excessive penetration may also produce surface irregularities which tend to hold the powder. As a rule, sandblasting adequately prepares the surface for magnetic inspection. For an extremely rough weld, however, it might be well to use a portable grinder.

Plate Laminations

One of the most important roles played by magnetic inspection in welding is the testing of rolled plates for laminations. It is the only known satisfactory method of non-destructive testing for the detection of laminations on the rolled plate edges. The most effective procedure is to place the prods on the plate edges approximately 6 to 8 in. apart. The powder is then applied while the current is flowing in the area between the two prods. The laminations thus discovered may be readily chipped or ground away before welding.

Interpretation

Generally, the majority of defects is found to occur parallel to the axis of the weld. Therefore, it is best to set up a magnetic field at right angles to the probable defects. The recommended practice is to shape the current by the use of prods directly parallel to the weld. This is accomplished by placing the prods at the sides of the weld, as before indicated. The inspection area is then observed by applying and removing dry magnetic powder while the current is flowing. The amperage required is determined by the thickness of the plate and the size of the weld being inspected. Normally, when the prods are 6 to 8 in. apart, a continuous current of 375 amp is used.

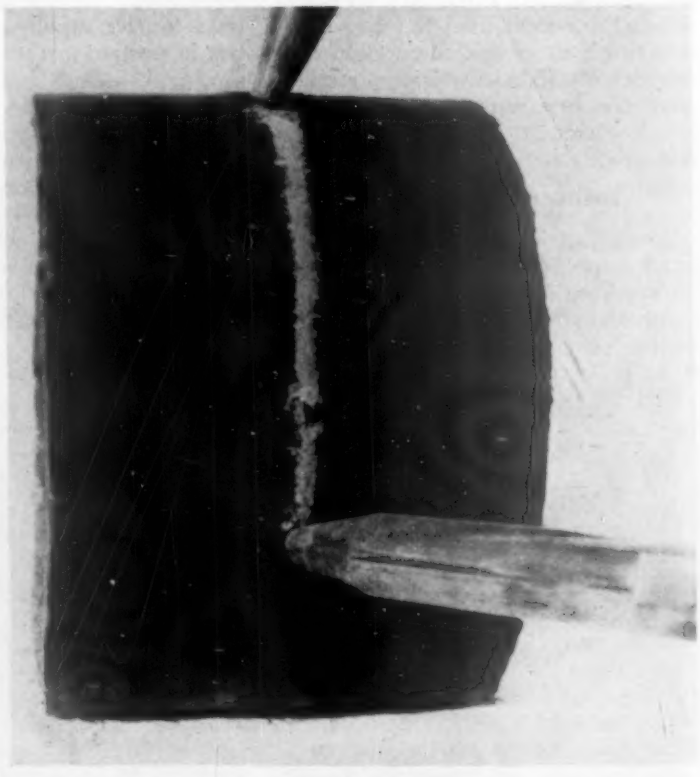
A surface crack will have a definite and distinct line of powder outlining the borders of the defect. Subsurface cracks are determined by wide fuzzy lines on the surface of the weld. The wider the powder indications, the greater the depth of the defect below the surface. For subsurface defects, the powder will not be held as firmly as in surface defects, and care must be taken in removing the excessive powder. Too much air pressure might easily destroy a subsurface indication.

Demagnetism

In certain applications, it is necessary to demagnetize the part after it has been magnetically inspected. This is particularly true of parts requiring further machining, engine parts and aircraft structures. Demagnetization may be accomplished by several different means. The usual practice is to use an A-C coil wrapped about the part to be demagnetized. (Care must be taken to see that the coil is in the east and west and not in the north and south fields.) Demagnetism is then accomplished by inducing an alternating current and gradually decreasing it while the part is removed from the coil. Parts may also be demagnetized by the use of D-C current by changing the terminals so that the direction of the current is reversed.

Fluorescent Inspection

Though not magnetic, fluorescent inspection is a recent development which produces somewhat similar results. This non-destructive method is suitable for testing non-ferrous materials and is accomplished by wiping a suspension of fluorescent materials in an oil vehicle over the object to be investigated. The article is then wiped dry. Should there be surface cracks, however, some of the fluorescent material will get into them, and these minute particles will glow and disclose the flaws when the article is exposed to an ultra-violet light. In some instances, fluorescent and magnetic inspection have been combined for ferromagnetic materials.



Pipe may also be readily inspected with magnetic particles, as is indicated in this picture. A magnetic field is established between the two prods.

Courtesy, Magnaflux Corp.

Welding Bell Airacobras

The speeded-up war production program has afforded electric welding a golden opportunity at the Bell Aircraft Corp., where the Army P-39 Airacobras are manufactured. Both arc and resistance welding are taking their places as important techniques in the production of our cannon-carrying fighter planes.

By **JOHN A. FORSYTH**
Asst. Superintendent in Charge of Welding, Bell Aircraft Corp.

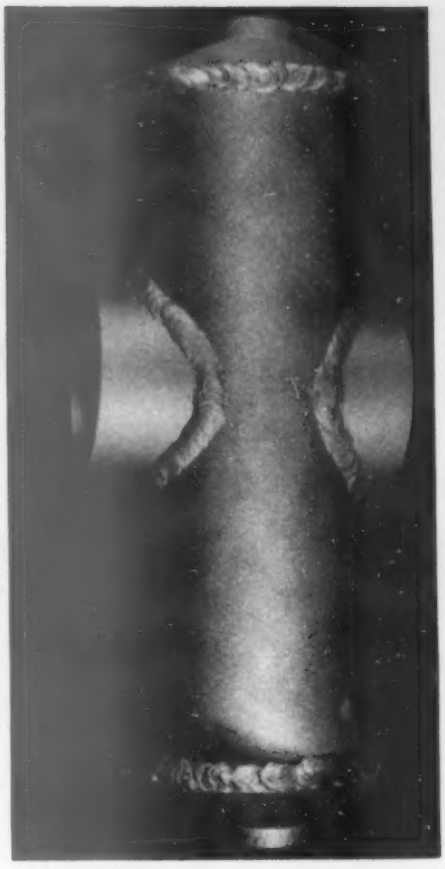


Fig 1—Stainless steel cannon mount pivot yokes on the P-39 warped badly as a result of application of the arc until a technique was developed to prevent abnormality of the ⅛ in. tubing to which end plates and bosses have to be fused. The trick was to weld half of the circumference of one end plate and then half the circumference of the other, reversing the side of the tubing being worked on when welding the second end plate.

EVER increasing production demands have brought into being all manner of improved methods in fabrication and assembly, from giant hydro-presses to constant-motion assembly lines, at Bell Aircraft Corp. Among the improved methods in mass and quality production in this industry (where sturdiness of structure is always in the engineer's mind even while he thinks of streamlining and speed), electric welding is proving itself as a means of speeding the fabrication of light gauge materials.

Arc and Spot Welding

The arc welding department of eight-year-old Bell Aircraft has been operating less than two years, yet it is handling many fabrication jobs of light gauge nature and daily turning out hundreds of Airacobra parts.

Spot welding has also increased in importance. In the past six months numerous fabrication assignments have been transferred from the riveting department to the spot welding machines. Spot welding at Bell Aircraft has relieved the overburdened riveting department of numerous assembly and fabrication assignments. In various instances, the spot welders have also relieved the gas welding department of minor jobs which fitted into the electrode-toothed machines.

Cannon Mount Pivot Yoke

Numerous problems demanding solution have arisen as arc weldors pioneered with light gauge material at Bell Aircraft. For example, the 18 in. of weld required for adding end plates and bosses to a tube 6 in. long of ⅛ in. stainless steel posed a problem that almost took the particular job from arc welding back to the gas welding department, where the part had been successfully fabricated for years.

The fabrication is for a pivoting yoke ultimately reaching the 37 mm cannon in the nose of the finished Airacobra. The end plates measure 3½ in. by 3 in. diameter, and the same stretch of the tape over the bosses shows 1½ in. Perfect balance is a prime requisite.

In completing the individual welding work on each accessory, a decided twist in the tubing had at first resulted from the intense heat of the arc. During the many years that the work had been done in the gas welding department no such distortion of the metal had developed, and for a time it appeared as though the particular work could not be adapted to electric welding.

Overcoming Distortion

This job, Fig. 1, was licked by welding half the circumference of one end plate and then shifting the work to the other end plate and welding half of the circumference there, on the opposite side of the tubing to the welding work done on the first end plate. With this much of the job finished, both end plates were fused to the tubing, each by a weld half the circumference of the tube, and the welding was, moreover, on opposite sides of the main object. By shifting the arc from one end of the tubing to the opposite end while at the same time reversing the sides of the tubing on which the arc was concentrated, the contraction and expansion tendencies of the metals were equalized, and the tube showed perfect symmetry when checked after welding.

To complete the task, the arc was returned to the unfused half of the first plate. After finishing the welding on that end plate, the arc was again directed to the other side of the tube for completion of the remaining half circle of unwelded tubing.

The rotation of the points at which the arc is applied to the light gauge tubing thoroughly eliminates abnormalities in the finished product. The same technique was followed success-

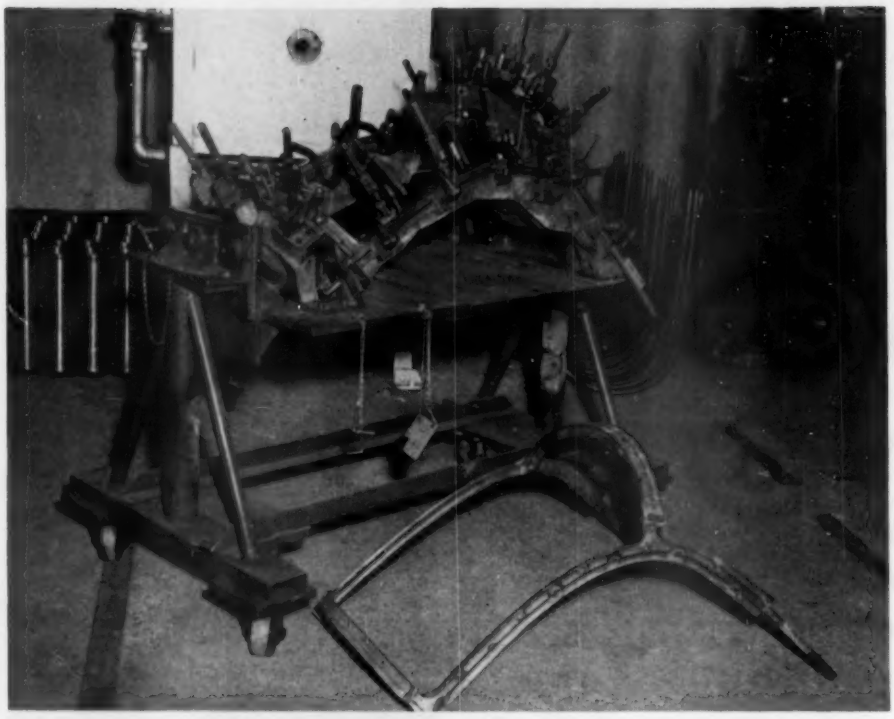


Fig. 2—This fixture holds the P-39 aft cabin frame of 0.032 in. sheet stock and 0.032 in. tubing in place for the welder. Switching from the carbon to the metal arc on this particular fabrication eliminated the mysterious pinholes which were previously found in the smoothing off process.

fully in fusing the two bosses to the center outside surface of the tube, and a perfectly shaped product resulted. The welding fabrication is now as sturdy as ever, even though the production of pivoting yokes has increased some 300%.

The Pinhole Mystery

Solving the case of the mysterious pinholes in another job, Fig. 2, tested the talents of the entire electric welding department. The welding of 0.032 in. sheet stock to 0.032 in. tubing was required in the fabrication of a portion of the aft cabin. A break-through hole was necessary in order to determine the thoroughness of the molten puddle. The carbon arc was utilized in the process, and a metallic filler replaced the necessary test break-through hole. The carbon allowed a neat job, as was desired in the particular fabrication, but the smoothing off operation invariably revealed pinholes. In an analysis of the experiment, the theory was developed that these were caused by minute particles of carbon discharged from the carbon electrode in piercing the fusing surface. The metal arc was substituted for the carbon, and at once the mysterious pinholes failed to appear under the smoothing process, substantiating the theory that particles of carbon had caused the flaws.

The above should not be construed as criticism of the carbon arc process. At Bell Aircraft, utilization of the carbon arc has been developed to such a degree that it now can handle a variety of delicate flange welding jobs.

Backing Plate Problems

As fabrication of light gauge material has steadily, though slowly, been assigned to electric welding, the use of copper backing plates has become popular because of their ability to equalize the heat resistance of metals of widely separated thicknesses. Techniques developed in working with the metal arc bring entirely satisfactory results on light gauge materials where the welded objects possess approximately the same heat resistance. Where the fusion of metal of widely separated thicknesses is demanded, however, the utilization of copper as a heat equalizer is becoming general. There are several light gauge jobs now being done in the electric welding department for which copper backing plates fulfill such a need.

Armor Plate Lock Cylinder

One such instance of utilizing copper is found in the fabrication of a cylinder for the armor plate lock, Fig. 3. This operation calls for a $\frac{5}{8}$ in. bar to be welded into a channel formed by bending a 1/16 in. sheet of chrome moly steel. The excessive penetration of the metal arc necessary to create a molten puddle on the bar damaged the lighter gauge 1/16 in. sheet until a copper backing plate was used. This plate is now part of the welding jig, where it completely equalizes the heat resistance of the metals. The cylinder fabrication which formerly consumed 12 minutes now requires but four minutes, time study records reveal.

Fig. 4 offers another instance of the incorporation of a copper backing

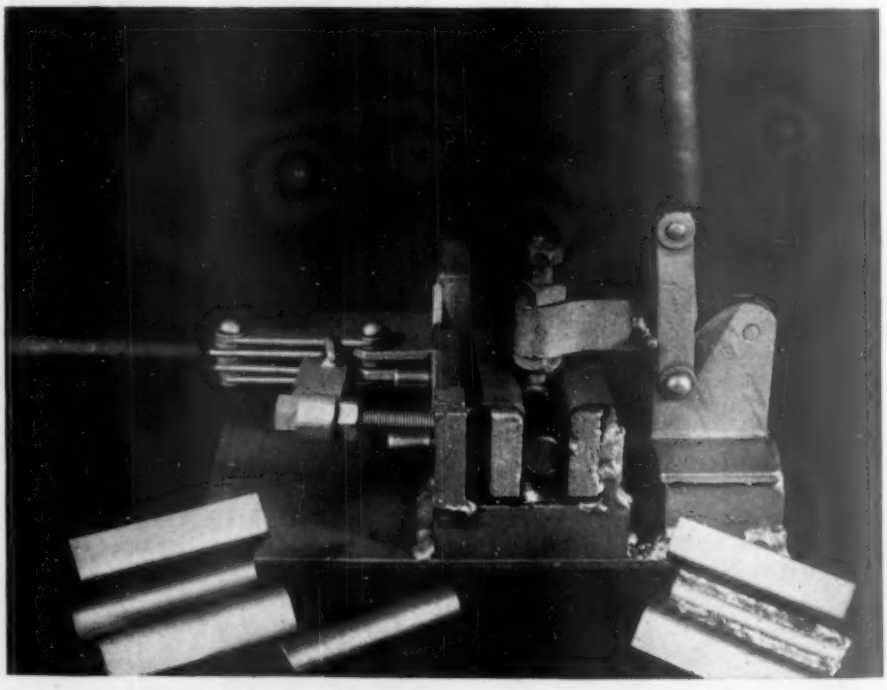


Fig. 3—A welding fixture designed with copper backing plates to permit the welding of 0.065 in. sheet stock to $\frac{5}{8}$ in. bar stock, in the fabrication of a cylinder for armor plate lock on the P-39 Airacobras. Before the copper was used, the extensive penetration necessary to form a molten puddle in the bar tended to burn through the thin sheet stock. In the foreground on the left is a cylinder ready to be welded and on the right is the finished product.

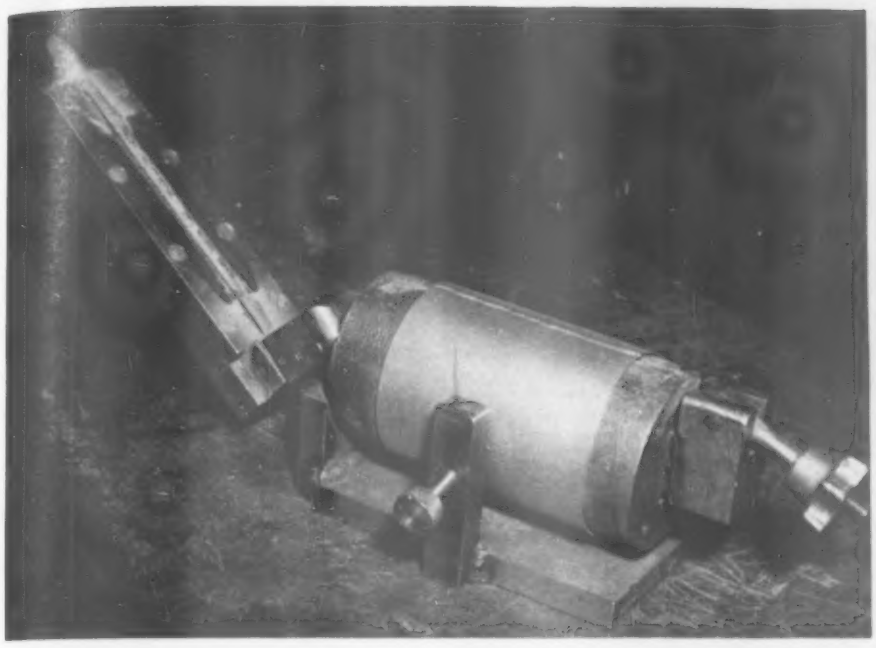


Fig. 4—This fixture was devised to permit total penetration of the arc in making an extremely strong weld on a P-39 flame blast suppressor of 0.062 in. stainless steel. The suppressor is fitted around a copper backing plate, which allows 100% penetration without burning of the light gauge metal.

plate into a successful job on light gauge material. Fabrication of a flame suppressor blast tube for the Airacobra's 37 mm cannon requires a 6 in. weld on a sheet of 0.062 in. stainless steel. An especially strong weld is required because the tube, after it leaves the welding department, will go onto a hydraulic stretching machine which stretches the metal to the full extent of its elasticity. This process is necessary to assure a perfectly true circumference, as the suppressor revolves with the motion of the multiple-speeded propeller, and the slightest deviation would cause a flutter.

To obtain a weld of the desired strength, 100% penetration is necessary, but this excessive penetration distorted the metal so that the tube became egg shaped. Pinholes also developed. To maintain the proper penetration while overcoming both the resultant distortion and pinholes, a jig was made which included a copper backing plate the identical shape of the suppressor. The backing plate allowed utilization of the total penetration without developing large amounts of residue on the inside of the tube.

Crater Eliminator Useful

Widely used in the fabrication of light gauge material in the electric welding department is a foot-controlled crater eliminator, which is easily adapted to the make of arc welders being used. One of the many jobs made possible through the use of this improved control is that of welding an inlaid brace to the sharp edges of a hoisting sling made of 3/32 in. stainless steel. Previously, the 30 in. of welding necessary to the job had brought numerous flaws in the work because the extended weld had necessitated a concentrated arc for a comparatively long period of time. Controlling the arc without the crater eliminator had previously proved impossible on such light gauge material.

Locating pins had to be replaced by a chain strap in the fabrication of gun blast covers. Fig. 5 shows two 0.032 in. tubes of 2 in. diameter welded to a cover of sheet stock 12 by 8 by 0.040 in. Locating pins had held the cover so snugly that space for expansion and contraction of the metal while under the arc was not allowed, and, as a result, the finished product contained a decided warp. The elasticity of the chain strap succeeded where the totally stable locating pins had failed.

Quite another technique is necessary in the fabrication of the bolt for the armor glass frame. A ½ by ¾ in. tab is welded to a bolt fitting in a slot. A concentrated arc had caused a burning of the metal edges. The solution proved to be to tack one side of the job and build a small weld there, and then jump the arc to the opposite side of the job and work back to the tack.

Ejector Chutes

The lightest gauge work done in the electric welding department at Bell Aircraft is on the fabrication of ejector chutes, Fig. 6, which are used in the ammunition cases of the .50 calibre guns. These chutes necessitate 18 in. of welding on 0.032 in. stainless steel. The carbon arc is employed, and all of the chute fabrication is done by women weldors, the carbon arc being

Fig 5—Locating pins in the 0.040 in. sheet stock used for P-39 wing gun blast covers had failed to allow sufficient room for expansion and contraction and, consequently, the sheet stock, which is fused to 0.032 in. tubing, buckled. A metal chain strap was substituted for the locating pins, its elasticity succeeding where the totally stable locating pins had failed.

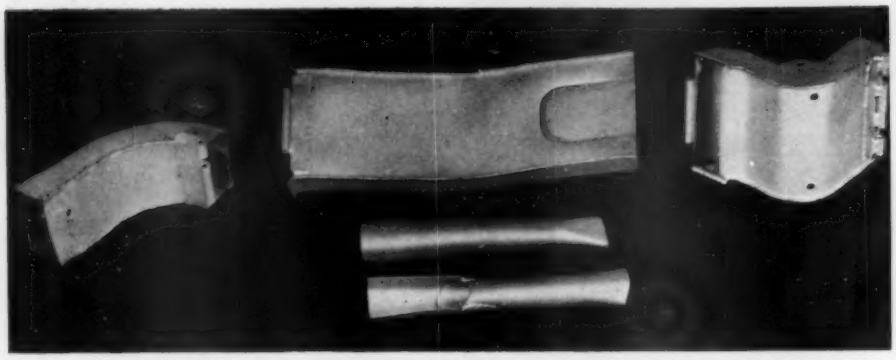


Fig. 6—The carbon arc is utilized in the fabrication of such light gauge material as 0.020 and 0.032 in. ammunition chutes. All such fabrication jobs are done by women, who find the carbon arc much easier to master than the metal arc.

considerably easier for them to master than the metal arc.

The carbon arc (as well as the copper backing plates in use in particular cases where the metal arc is utilized) affords the department excellent scope for the employment of less experienced weldors in the welding of flanges and other light gauge material on which, previously, only skilled weldors could work without burning the edges.

The atomic-hydrogen welding process, also in use at Bell Aircraft at the present time, permits the welding of alloys of opposite basic structure. A hydrogen flame veils the actual arc and protects the fusion point from the presence of oxygen.

Conveyor Cleaning System

In the spot welding department, one of the greatest time-savers and production boosters ever utilized is a new conveyor system for cleaning aluminum alloys in 1,000 gal vats of chemical cleaning fluid. A conveyor similar to models used in steel mills was installed, and in two weeks the department was able to release 65% of its hand-cleaning personnel for other work.

The conveyor cleaning system, Fig. 7, is made up of three major parts: a sewage tieup which, with the turn of a valve, may draw off the vast capacity of the vats; five vats, each holding 1,000 gal of liquid, and a hydraulic conveyor. The latter revolves to given stations, lowers its load into the vats and withdraws them at the desired time.

Each of the six stations on the revolving conveyor has a flat galvanized screen which may be removed and replaced in Station 1 of the circle of vats below it. Like the conveyor itself, the circle of individual vats below also consist of six stations. Station 1 is the loading and unloading station, "2" the vapor degreasing tank, "3" a vat filled with aluminum cleaner kept at a boiling point by an automatic heating system, "4" a vat furnishing a hot-water rinse, "5" a vat which contains the dioxide cleaner, and "6" a vat furnishing a second water rinse.

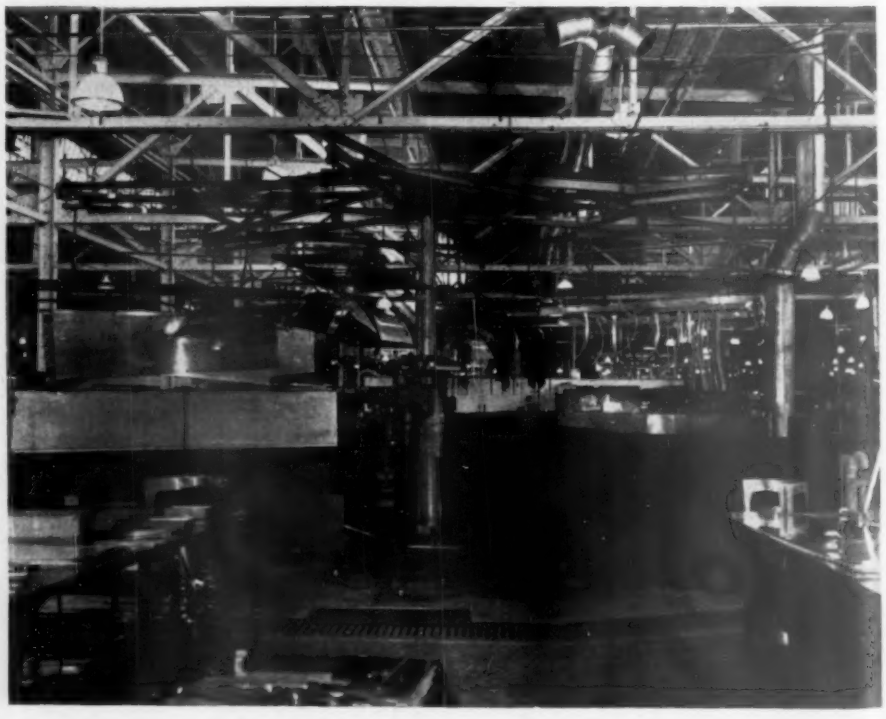
The large conveyor automatically takes the aluminum objects in order from the Station 1 vat to the next and through the complete cycle. Each dipping is set for a period of five minutes, although the conveyor may be regulated for any given amount of time. As Station 1 of the six station conveyor raises its contents out of the first vat and carries it to the second vat, Station 2 of the conveyor follows. As Station 1 of the conveyor lowers its contents into the second cleaning vat, Station 2 on the conveyor starts the cycle by lowering its contents into Vat Number 1. Thus the cycle continues with a full capacity of objects at each station. Loading and unloading of the conveyor takes place at a station between the fifth and first vats.

The conveyor system and the chemical cleaning fluid have proved to be a great improvement over hand cleaning with steel wool, the method previously employed. Alloy cleaned by steel wool had always been bothersome to welding operators, who were forced to clean their welding tips regularly after each 45 or 50 welds. Now as many as from 400 to 600 welds between tip cleanings are possible when working with alloys which have been chemically cleaned.

Any aluminum alloy may be thoroughly cleaned in the fluid, the Bell spot weld department has found. Small jobs which cannot be attached to the conveyor screens by the regular stainless steel hooks can be held in small stainless steel baskets.

A crew of 45 girls, which once did the cleaning of aluminum alloy in the spot welding department, had had a difficult time in keeping ahead of the spot weldors. The one conveyor now in use could furnish thoroughly cleaned metal for three times the total number of spot welding machines in the department. And this superiority in mass production holds true despite the fact that the operators work much faster on chemically cleaned metal than they did on metal cleaned by hand with steel wool.

Fig. 7—This chemical cleaning conveyor has eliminated the need for hand cleaning of aluminum alloy stock prior to spot welding. The conveyor revolves above huge vats filled with cleaning chemicals and water rinses.

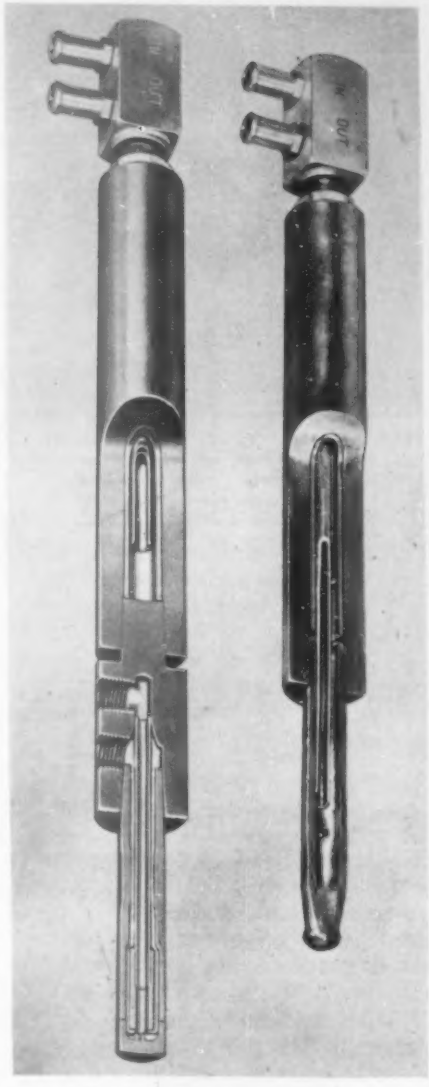


★ RESEARCH

Refrigerated Electrodes

"Is refrigeration really worthwhile for spot welding?" industry has been asking for some time. Unfortunately, there has been a large amount of conflicting evidence. This authority presents new facts which may help the reader find the true answer to the puzzling question.

By **A. L. MUNSON***
Manager, Frostrode Products



Refrigerated electrode with adapter (left). Water cooling is used above the adapter, confining refrigerant cooling to the comparatively small section just above the tip. The thin walled coolant tube and finned cap also help to make refrigerant cooling practicable. The conventional spot welding electrode (right) cannot be efficiently refrigerated because of its thick walled coolant tube and the wasteful refrigeration of electrode holder and welder arm.

THE spectacle of two pieces of metal bristling with white frost coming together on two strips of aluminum and making a weld is spectacular and appeals to the imagination because it is so contrary to preconceived notions of natural phenomena. When we think of welding, we think of heat—glowing red or dazzling white—which causes metals to fuse together in a strong bond. But it is just this combination of opposites—heat and cold—which is now being used for aluminum spot welding.

High Currents, Short Times

Aluminum is a tricky metal to spot weld. For one thing, it has a low specific resistance, which means that the current requirements for welding aluminum have to be three or more times the values used in welding steel of similar gauge. A spot welder designed to weld two pieces of ⅛ in. thick steel will not be nearly heavy enough to weld the same thickness in aluminum. Moreover, the "Weld Time," that is the duration time in which the welding current is applied, must be very short, since a very high current is used, in order to avoid burning of this easily burnt metal.

Aluminum likewise has a tendency to form an oxide scale of high melting point. The work must be cleaned of this oxide and other impurities before a weld can be made since wide variations in the welding heat can be caused by variations in the contact surface resistance because of foreign matter on the surface.

The surface resistance of aluminum is increased by the presence of foreign substances which have been deposited either by handling or by chemical action of the atmosphere. Fumes, smoke, moisture, etc., in the atmosphere will have definite effects on the oxide coating. Dirt, grit and dust will also cause some trouble and can often limit the number of spots obtainable between electrode cleanings.

Premature "pick-up" of aluminum by the electrode face will also result if the surface is contaminated, and, even with proper cleaning, aluminum has the unhappy faculty of picking-up soon enough. For all of these reasons, the cleaning of aluminum is a very important matter, and it is given a great deal of serious attention by all good welding engineers.

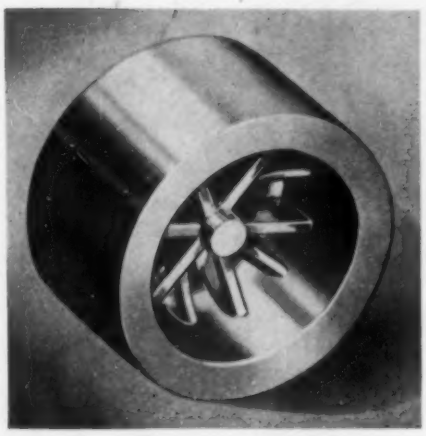
Clean with Care

There are two commonly used cleaning methods—chemical and mechanical cleaning. Each method has its boosters, but chemical cleaning seems to be the most popular. Extreme uniformity can be obtained with the chemical baths, and this is important because it is impossible to produce consistent welds without uniformity.

Little skill is required by workers operating chemical cleaners since they need only to load and unload the tanks on a definite schedule. The high uniformity desired is obtained simply by controlling the length of time in which the material is dipped in the bath. Finally, more spots can usually be obtained between electrode cleanings with this process. On the other side, however, a rather elaborate and expensive initial installation of tanks, hoists, baskets, etc. is required, and the workers must exert care to avoid damage or injury from chemicals and to time the cleaning process accurately.

Mechanical cleaning requires skilled operators who must exercise great care in removing the oxide coating so as not to thin or roughen the surface of the sheet. Offsetting this advantage, the mechanical method allows the cleaning of any part of a surface without treating the entire surface, and the initial equipment required is small and inexpensive. While cleaning

*Abstract of a paper presented before the American Society of Refrigeration Engineers, Cleveland, June 2.



Replaceable cap for new refrigerated electrode. The internal-fin structure gives cooling efficiency.

will not be as uniform, careful operators can obtain satisfactory results.

Whichever method is used, care should be taken to weld the metal as soon after cleaning as possible—preferably within an hour or two, and certainly within 24 hours—to prevent recontamination of the cleaned surface.

Why Refrigeration

Aluminum readily alloys with copper, especially at high temperatures. It is, thereore, very important that the temperature of the copper electrode face in contact with the aluminum be kept as low as possible in order to avoid "pick-up" of the aluminum being welded. This, then, is the basic reason for the use of refrigeration. We try to hold this face temperature down below the fusion or alloying point in order to retard alloying. If we could consistently prevent pick-up, we might conceivably be able to weld forever on one set of electrodes.

When the welding machine has been properly set for the work to be done, and the work properly cleaned, welding operations can begin. First, a number of sample welds are made solely to check the control settings. Too much current will cause "spitting" or burning, plus the danger of serious accidents when molten metal splatters from the weld. Insufficient pressure will also cause spitting. Too much pressure causes objectionable indentations in the sheet. Too little heat means weak welds, and shear strengths must meet rigid specifications. An accurate middle mark must be reached before production welding can begin.

This brief summary of welding practice indicates what we are up against when we try to apply refrigeration to a welding machine. There is no easy way to determine refrigerating loads. Each type and make of welder must be treated differently. Each size or thickness of sheet requires a different heat. The condition of the sheet will cause variations. The type of oxide coating will cause wide variations. Each alloy will be different.

The condition and type of electrodes will cause very wide variations. The throat depth and height must be considered. Any ferrous metal in the throat field will make a tremendous difference. Other important factors are the method of cleaning, consistency of cleaning, atmospheric conditions and the polarity of the electrodes.

On the Firing Line

The cooling surface available in the electrodes is of the utmost importance. Only recently, however, has any attention been paid to this factor. Electrodes are right on the firing line—they come in direct contact with the weld and also carry the current. Let us consider them for just a minute.

Dr. F. R. Hensel, metallurgical consultant for the P. R. Mallory Co. and a recognized authority on electrode metallurgy, has studied the relative rates of temperature recovery for water-cooled versus refrigerant-cooled electrodes, the temperature gradients in a standard electrode, relative heat effects in electrodes from weld heat and from the joule effect in electrode material, and the deterioration of spot welding electrodes as affected by water-cooling versus refrigerant-cooling.

The Joule Effect

According to these investigations, a considerable portion of the heat effects in the electrode resulted from the joule effect (the change in resistance due to heat) of welding current passing through the electrode material. After 20 spot welds with water-cooling, a temperature average of approximately 138 C was measured with a thermocouple buried approximately 0.056 in. behind the electrode face. An average temperature of 93 C was measured under the same circumstances when no material was between electrodes. After 20 spots with refrigeration, an average temperature of 120 C was measured, and 45 C was measured when no material was between electrodes.

This indicated, first, that the joule effect in a standard electrode is a considerable factor in determining total heat and cannot be neglected when estimating refrigeration loads. Secondly, it indicates definitely that the conventional electrode cannot possibly be cooled sufficiently to justify the use of refrigeration. Only an 18 C reduction in temperature was measured when refrigeration was used instead of water cooling. A special electrode design was necessary if the benefits of refrigeration were to be obtained.

Deterioration of Electrodes

In spot welding of steel, stainless steel or other relatively hard metals, electrode deterioration will occur principally through plastic deformation or "mushrooming" of the electrode face. This causes the contacting area to vary and decreases the current densities in the weld area. In time, therefore, the weld strength will decrease below a minimum standard, and the electrodes must be redressed.

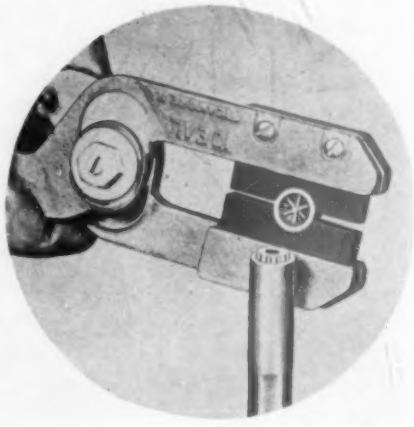
Electrode tips are commonly dressed with a file and/or oxalite paper of fine texture abrasive. This cleaning is one of our worst headaches since it occupies so much valuable production time. It usually takes from 5 to 20 min to clean one set of points.

It has long been felt that if electrode face temperatures could be held low enough, pick-up and mushrooming could probably be entirely eliminated.

Hard drawn copper, which has the best electrical characteristics, would make the best electrode material providing that it could be kept hard. Thousands of dollars have been spent by welding companies and electrode manufacturers in trying to make copper electrodes that would really work. However, in each case they failed because they were unable to retain the copper's hardness. They were all forced to go to a copper alloy which, though much less efficient electrically, retained its hardness longer.

Hard drawn copper anneals quite rapidly at approximately 600 F. Most

Lifting off the cap. A low melting point silver solder seal is melted with brazing tongs when cap is removed for replacement.



Package-type refrigerating unit (right) being used with a condenser discharge aluminum welder. In general, it is advisable to have a separate refrigerating unit with each spot welder.

of the alloys used for spot welding electrodes have an annealing temperature of approximately 900 F or less. Even these harder alloys mushroomed because of inadequate cooling methods which were unable to prevent the metal temperature from rising to 900 F. Consequently, electrodes had to be filed off or faced again. This became common practice in the industry; it has been going on for years, and until recently was accepted as a necessary evil.

New Points, New Troubles

Every time an electrode point is dressed it brings in another variable. Point faces cannot easily be returned to exactly the same contour. A new point means a slightly larger or smaller area spot with a different resistance and requiring different current intensity for a shorter or longer time. Hence machine control settings had to be readjusted every time a point was redressed. New weld samples had to be taken and shear tests run—all of this consuming time which could be used to better advantage in war production.

Actual production tests run with copper alloy electrodes have provided some interesting and illuminating data. Starting with an alloy having a hardness of 82 Rockwell B, another hardness test after a few hours of normal welding showed that the face hardness of the electrode had dropped to 25 Rockwell B. After a few more hours of welding, the electrode face was so dead soft that it didn't register at all on the B scale. Obviously, the hardness had been drawn from the alloy because of heat absorbed by the electrode. It follows logically that cooling would eliminate this annealing process, always providing the cooling could keep the electrode metal at a temperature below the annealing range.

As before pointed out, it immediately became apparent that only a small amount of the available cooling from the refrigerating unit could be effectively used with spot welding electrodes of conventional design. Work was begun on an improved electrode design. After months of hard work, a refrigerated electrode was developed and placed in a dozen plants for trial production runs. Results were immediate and dramatic.

Reports began pouring in: "Runs were increased in ratio of 10 to 1." "Improvement with refrigerating unit alone was 300% but now is 600% with unit and electrode." "We were making four to six spots between cleanings, but now can make 399 spots." "Cooling efficiency greatly increased." "Were getting 40 to 50 spots, now getting 400 to 500 spots on 0.040 and 0.064 in. sheets."

Copper Savings

The War Production Board became interested because of the great potential copper savings. Instead of discarding an entire electrode, only the replaceable cap is expendable—½ oz of copper instead of 6 oz.

Efficient cooling made possible the use of a hard drawn, cold worked, replaceable-cap electrode. Production tests proved that the original 55 to 60 Rockwell B hardness of the hard copper cap was retained and no annealing occurred. Refrigeration prevented the metallurgically harmful high temperatures which had heretofore been a common and an accepted evil.

The replacement cap achieves its hardness from cold forging, which provides a close grain hardness. Internal fins give greatly increased cooling area for better and more rapid heat transfer. This structural arrangement permits the use of much less metal between the electrode working face and the coolant.

Cooling is needed primarily only at the electrode face. Special electrode holders were developed to concentrate all cooling effect in the tip, thus eliminating the losses caused by trying to cool the entire electrode and welder arm.

All these factors and more must be carefully considered when refrigeration is to be applied to welding. Each type of welding machine is different in operating characteristics. The variables encountered are staggering, and only an individual with welding knowledge and experience in this type of application can hope to solve them successfully. But when properly designed and applied, refrigeration can work miracles in speeding aluminum fabrication in spot welding operations. And since spot welding is so much easier and speedier than riveting—it's almost like using a sewing machine on sheets of aluminum—this country of ours is really turning out planes faster and faster every week. Most aircraft plants now occupy areas which must almost be measured in terms of latitude and longitude.

2,000 Spots between Cleanings

But many people still ask, "Is refrigeration really worthwhile?" There has, unfortunately, been some conflicting evidence in the welding industry on this. There have been papers pro and con which have tended to confuse. Some plants say it isn't worth the extra cost—that the improvement is not great enough. It has been our experience, however, that when *properly applied,* refrigeration has invariably shown considerable and worthwhile improvements.

By using the new type of spot welding electrode with the refrigeration unit, we have been able to make as many as 2,000 spot welds on 0.064 in. 24ST Alclad between cleanings. The shear tests were unusually consistent, and the welds were entirely acceptable.

On the stored energy type welder, which is more difficult to cool, field production tests have shown 600 to

900 spots on the same material between cleanings. Previously, 30 to 50 spots have been considered a good average. This is a very real improvement.

Best Coolant Temperature

The best coolant temperature, we have found, is between 0 and 10 F for most (especially light gauge) work, although we can furnish units arranged for 30 and 40 F. A minimum of 2 gpm should be circulated in each electrode. There is some evidence indicating that for light gauge aluminum (0.020 in.) a temperature of 15 or 20 F works very well. However, we have standardized on 0 to 10 F since it has given much better results in by far the greatest number of cases.

For steel work (such as in gun-type welders), we often use 40 F, but even for steel we have found O F very desirable. For example, a O F temperature is used with one make of welder which permits very accurate postweld heat treating through use of a thermocouple inside one of the electrodes. With this welder, armor plate can be very successfully welded and heat treated after welding with electrode at a O F temperature. A series of pulsating electrical currents of varying intensity is used so that any predetermined degree of heat can be obtained very accurately. It is, consequently, quite simple to obtain approximately the same hardness and toughness in the weld as was in the original metal. Refrigerated electrodes assist in the quick quenching and also greatly retard mushrooming of the points.

Spot welded armor plate, it might be noted, is being used more and more. Armored vehicles so fabricated have stood up extremely well under fire on many battlefronts.

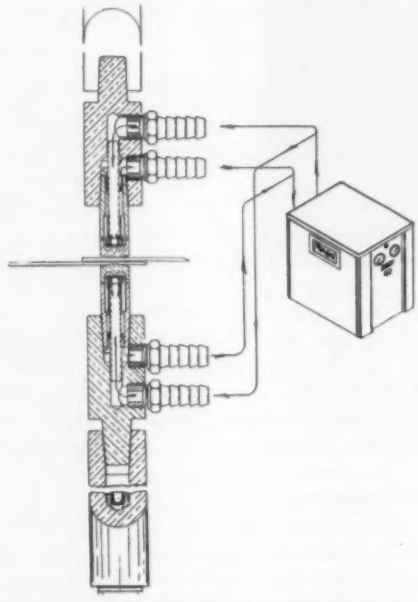
Types of Systems

Direct expansion systems were first tried for cooling the electrode. However, the moisture bugaboo immediately came up as the first and worst obstacle. At the present time it looks extremely doubtful whether direct expansion can be successfully applied and made foolproof. The electrodes must be removed too often to change shape or renew. If direct expansion coolants are used, this would mean actually opening a refrigerant circuit, and to offset moisture pick-up you would need a dryer as big as a house.

The present method is to cool the electrodes with a mixture of antifreeze, such as alcohol and water, which is fed to the tip through rubber hose and a ¾ in. iron pipe. It is very important for uniform results that equal amounts of refrigeration be supplied to each electrode.

Wall Thickness Reduced

When we first entered the field, we found that tip thicknesses ranging up to ¾ in. of metal between the coolant and face of the tip were in common usage. Naturally, this provided an overwhelming wall for the refrigeration to work against. Changes in electrodes since then have reduced that wall thickness to the thinnest dimension which will maintain the weight of the electrode under pressures encountered on the job.



Schematic diagram showing how refrigerated coolant is circulated through the adapters to the electrode tips and returned. Tip pick-up is greatly lessened when welding with electrodes at a temperature of O F.

Effects of Refrigeration

Refrigeration increases the current carrying capacity of the electrode at low temperature. Among other authorities on this subject, Dr. Hensel has published a very good paper which appeared in *Air Conditioning and Refrigeration News*.

Refrigerated electrodes produce no appreciable effect on shear strengths of the welds. Nor does refrigeration have any effect on cracks.

It's impossible to say offhand what size unit will be required for a given job. Loads can only be determined from experience and welding knowledge; there is no easy formula.

Central System vs Small Units

In a few cases, a central system can be advantageously employed. However, the small package-type units have a great many advantages and are much more widely used. The small, compact units can be easily adjusted or moved. They become a permanent part of the welding machine and are so considered.

Plant flexibility is extremely important these days. So, unless there is definite assurance that the welder arrangement will remain the same for a long time, it is unwise to attempt to use a large central system. Plant economy must also be considered. It would be the height of folly to operate a 100 ton plant compressor and brine pump to cool one or even a dozen welders. Unless all or almost all of the welders are being used steadily, do not use a large central system.

It is conceivable (in view of the rapid strides now being made), that different types of work and materials will require different electrode coolant temperatures for best and most consistent results. It would be difficult to accomplish this with a large central system.

Much important war work might be held up if a break-down occurred in the single large compressor or pump. With a small unit on each welder, a compressor breakdown would affect only one welder. Moreover, an entire unit can be kept as a spare and put in service quickly.

Factors to Consider

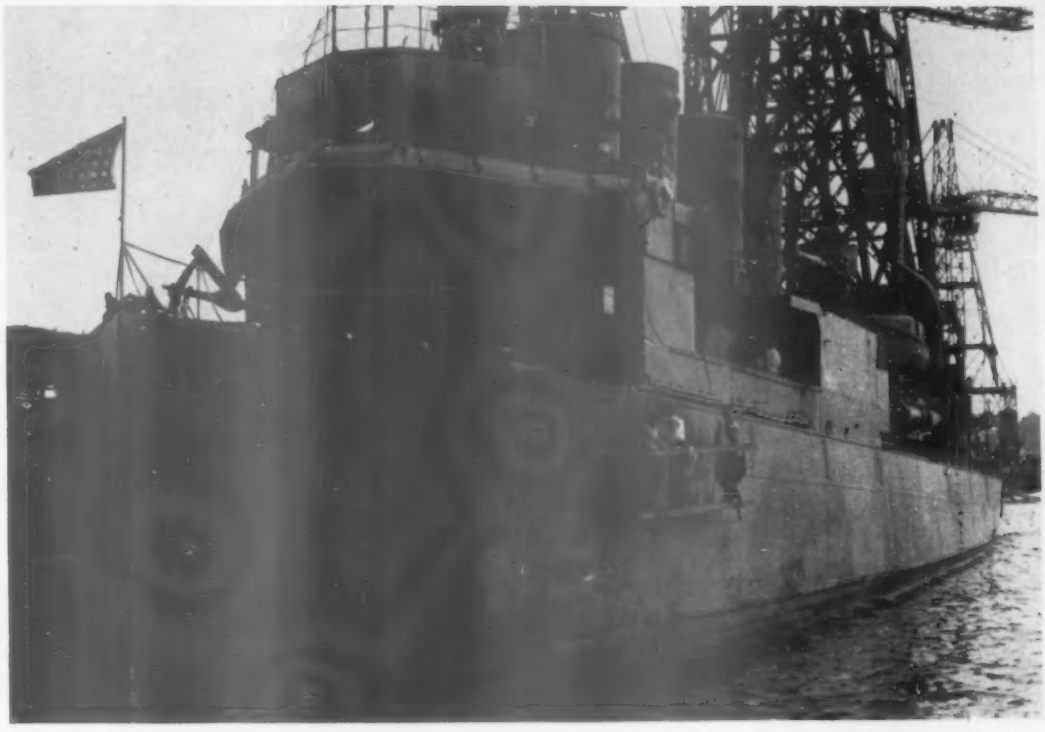
The weld nugget should penetrate between 60% and 80% of the thickness of the overlapping joints. No amount of refrigeration will keep the melting metal cool if the weld penetrates the surface of the sheet. A good spot weld will be stronger than an equivalent rivet and will provide a smooth, flush surface. Frequent shear samples aid in the determination of a good weld.

The weld time required for an aluminum sheet weld is less than one cycle in duration. More prolonged heating would cause the sheet to buckle and result in a poor weld.

In portable gun welders, the welding cables and also the welding transformer are often cooled with refrigerant. This provides much longer equipment life and makes the welder entirely independent of a water supply.

In summation, we have done a great deal of experimental work, both in the laboratory and in the field, and have proved to our own rather critical satisfaction that, when properly applied, refrigeration is very beneficial to resistance welding. Some jobs could not even be attempted without it.

Yes, refrigeration can help to remove a serious industrial bottleneck, but in applying it a thorough grasp of welding knowledge and technique is necessary.



Minus her bow, the USS Blakeley arrives at the Philadelphia Navy Yard. Note the temporary bow which was given to this destroyer at a West Indies Naval Repair Station.

All pictures Official U. S. Navy photos

Destroyer Takes a Bow

Flame-cutting and welding, plus a decommissioned sister ship, put the USS *Blakeley* back in service.

OUR Navy weldors are ingenious whether on land or sea. Many examples of their ingenuity will be told only after the war, but here is one striking example of Navy welding ability which can be told now.

The story begins in the Spring of 1942 when enemy submarines were taking a deadly toll of merchant ships in the Caribbean. In a good many instances, this battle seemed to be quite one sided—our side generally the loser. This was not exactly true, however; U. S. Navy destroyers were at hand, and they were also taking their toll among the Axis submarines.

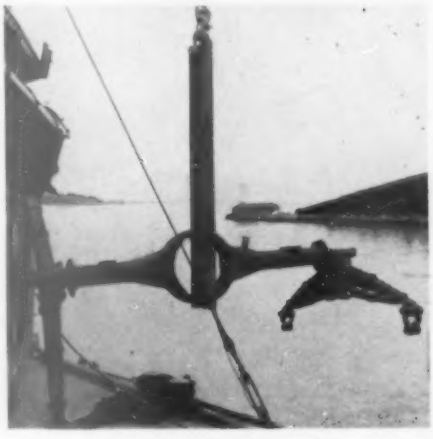
The USS *Blakeley* was on such a mission when an enemy submarine struck what might well have been a fatal blow to this destroyer. A torpedo was shot into the *Blakeley;* in the resulting explosion, her bow was blown away, ten sailors were killed and six injured. Serious though the damage proved to be, however, the consequences would have been much graver had not an able crew met the emergency with prompt action. They quickly closed the watertight doors of the transverse bulkhead, which held and kept the *Blakeley* afloat.

An Anchor from Scrap

Still able to ward off further attacks, the destroyer headed for the nearest friendly port. There her gaping bow was fitted with a wooden bulkhead to keep out the sea ahead of the transverse watertight bulkhead which had served so well. While the wooden bulkhead was being fitted, the *Blakeley's* welding crew proved its resourcefulness by building a new anchor to replace the one lost when the bow was blown from the ship. The improvised anchor, Fig. 1, was built from scrap—the only available material in this small seaport. A section of railroad rail formed the stock; the rail was welded to a truck axle housing to form the arms. The springs attached to the housing became a worthy substitute for flukes.

When the new bulkhead was finished, the destroyer took on the appearance of a barge, but, despite her looks, the craft was much more seaworthy. Ready for further travel, she proceeded to a United States Naval Repair Station in the West Indies. At this base, welding began to contribute to the reconstruction of the destroyer. The Naval Station

Fig. 1—A section of railroad rail, a truck axle housing and a pair of springs were converted by welding into an anchor to replace the one the Blakeley had lost.



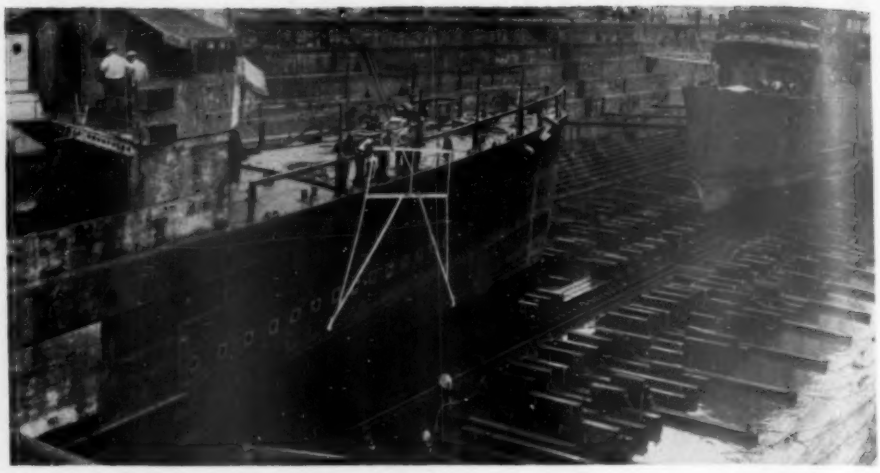


Fig. 2—USS Blakeley and USS Taylor in dry dock together. Note the markings for the flame-cutters.

Official U. S. Navy photos

weldors fabricated a bow which, though of a temporary nature, proved to be suitable for a long sea voyage. The temporary bow (a somewhat modified model bow) was sufficiently streamlined to allow the *Blakeley* to travel an open sea at a rate approaching the normal speed of a vessel of her type. It must have been reassuring to the crew to know that their vessel was not to be easy prey to the other enemy submarines which might be lurking along the sea lanes during the long voyage to Philadelphia.

Final Repairs

On July 13th, 1942, the *Blakeley* returned home to the Philadelphia Navy Yard, and soon the weldors there were beginning one of the strangest refitting jobs ever undertaken. Naval architects, analyzing the damage, decided that the easiest way to repair it would be to cut a 60 ft bow section from the USS *Taylor*, a decommissioned ship of the same type as the *Blakeley*. Both ships were consequently ordered into dry dock, and the work began.

First, the hulls of both destroyers were marked off (Fig. 2) so that the flame-cutting operators might cut out the pieces of the jigsaw puzzle which was to result a month later in a recommissioned destroyer for the Navy. The bow of the *Taylor*, including its many stiffeners, decks, floors, longitudinal bulkheads, pipelines, etc., was severed from the remainder of the ship, and a shipyard crane was called into the play. This large crane (Fig. 3) lifted the 60 ft nose of the *Taylor* with ease and swung it around so that it might be fitted onto the sister ship.

Welding Relatively Simple

Proof that the flame-cutters did an excellent job is provided by Fig. 4, which shows the manner in which the pieces fitted together

After the riggers had completed the aligning and blocking of the *Blakeley's* new forward end, the weldors went to work. The actual welding was a simple job—no more difficult than routine shipyard welding. Soon the *Blakeley* was ready for further service in our country's Navy with a new life of usefulness in prospect.

Though deprived of her bow, the decommissioned *Taylor* remains at hand to continue to play a part in the winning of the war. In the Battle of the Atlantic, it is never known when another destroyer may need a midship section or stern. Should such an occasion arise, the parts of the *Taylor* remain and another grafting job may be done, for, as you know, Navy weldors are ingenious—very!

Fig. 3—This large crane lifted the severed nose of the Taylor and swung it around for fitting onto the sister destroyer.

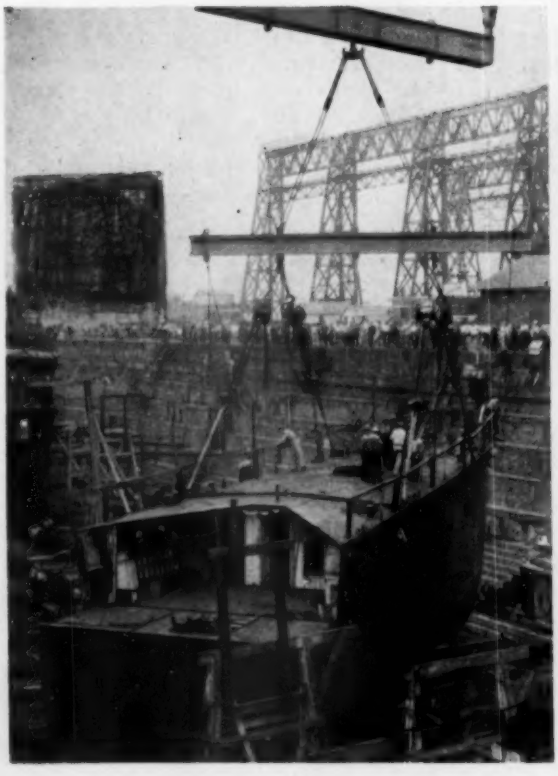
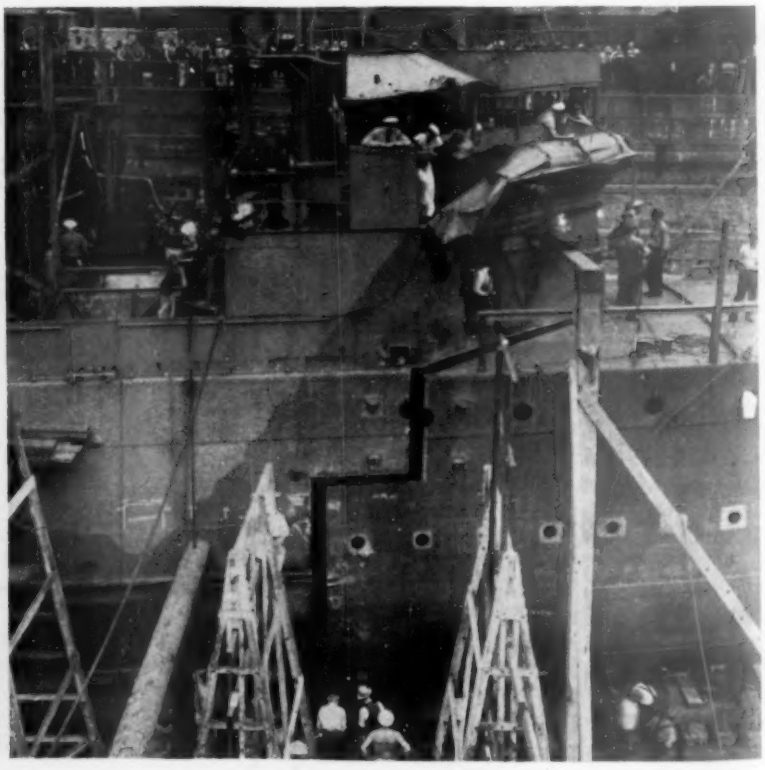


Fig. 4—The pieces fitted together like this, proving that the flame-cutters had done a careful job. Only routine shipyard welding is needed from this stage on.



Silver Alloy Brazing

Thousands of manufacturers who once prided themselves on completely stocked tool cribs have during the past two years met face to face with the wartime necessity for tool salvage. The author gives timely information on the applications of silver brazing to tool repair.

By **A. M. SETAPEN***
Industrial Engineering
Div., Handy & Harman

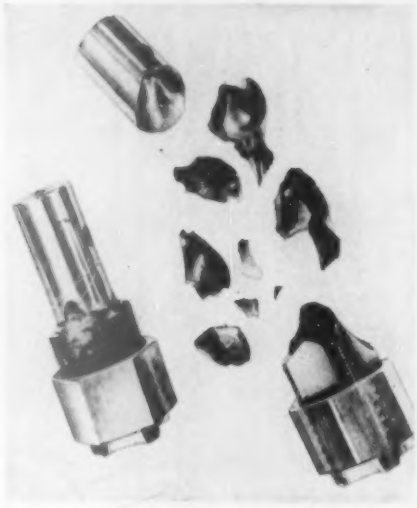


Fig. 1—Shattered tap. Difficult as the task appears, these fragments can be joined into a useful tool by silver brazing.

WHEN a precious, hard-to-replace cutting tool breaks during these days, the pieces are carefully picked up and taken—not to the scrap metal pile but to the tool room! The fight for Victory is only interrupted for an hour or two, and then the tool is back on the machine completely repaired. Most likely, the repairing has been done with a low temperature silver brazing alloy; these alloys are coming into wide usage for tool salvage work because of their low melting points and the fact that only a thin film of alloy in the joint area is necessary in order to get high joint strength.

Let's follow a tool through the salvage department and get a step-by-step picture of good brazing procedure.

Restoring a Shattered Tap

Even such a specimen as the shattered tap shown in Fig. 1 may be repaired by the silver brazing method.

The equipment needed to restore this tap consisted merely of an oxy-acetylene torch, a small length of $\frac{1}{32}$ in. diam silver brazing alloy wire, a jar of flux, a few ounces of carbon tetrachloride and a small length of nichrome wire for holding the parts while brazing.

In making this repair, the first step was to clean the pieces individually with carbon tetrachloride. Care had to be exercised to make certain that each piece was scrupulously clean and bright. Cleanliness beyond any shadow of a doubt is the first law of good brazing practice. All surfaces of the pieces were next fluxed. It is important to use a silver brazing flux which is entirely liquid and active in dissolving oxides at the exact temperature required for silver alloy brazing. The parts were now assembled and wrapped tightly with nichrome wire, making certain that all pieces were seated perfectly. Rather than one continuous piece, it is preferable to use several strands of wire, inasmuch as this lessens the danger of the wire becoming loose when the tool is heated. Needless to say, the pressure on the wire must be maintained throughout the braze to insure a close fit between parts.

Heated with Torch

Heat was applied to the tap with an oxy-acetylene torch; the torch was chosen primarily because of its speed in heating the tool steel to 1,175 F—the alloy's melting or "flow" point. In silver alloy brazing, a neutral to reducing flame should be used and the torch kept in constant motion to assure that the tool heats evenly. The action of the flux is of aid in determining the amount of heat to apply; when the flux becomes entirely liquid and clear, the temperature of the tool is approximately 1,100 F. The color of the metal should also be watched carefully, for it is unnecessary to destroy the tool's hardness by heating it above 1,175 F.

When the metal glowed a dull red and the flux was completely clear and liquid, the joints had only to be touched with silver alloy wire ($\frac{1}{32}$ in. diam in this particular case), and the alloy was pulled by capillary attraction throughout all joint areas. The alloy was thus fed until visible evidence was obtained that all breaks had been completely filled.

The final step was to air blast the tool assembly in order to cool it quickly to 1,000 F. This action is recommended in order to preserve the tool hardness. Tests have shown that very little, if any, hardness is sacrificed if the tool is heated quickly to brazing temperature and brought back without delay to 1,000 F by air blasting.

Other Tool Repairs

Generally speaking, the simple brazing procedure above described is followed rather closely by our laboratory

* Paper given at annual meeting of the American Society of Tool Engineeers, Milwaukee.

Fig. 2—A broken form cutter before and after repairing. This tool was heated to brazing temperature in a furnace because of its size.

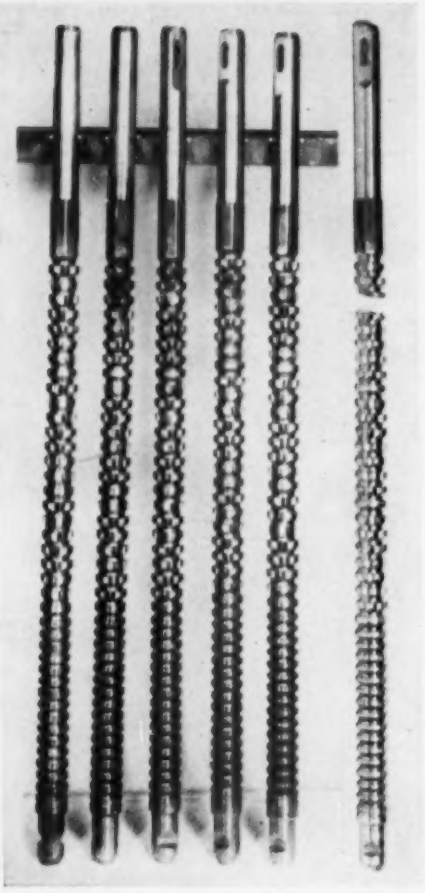


Fig. 3—Five-foot broaches after being repaired. A broken broach is shown on the right. An oxy-acetylene torch was used for heating.

when called upon to demonstrate the art of repairing badly shattered tools which are not to be subjected to service temperatures above 800 F. Additional examples of such tool repairs are provided by Figs. 2, 3 and 4.

Furnace Heated Cutter

Fig. 2 shows a form cutter broken in a number of pieces and the results of the repair. This tool was heated to brazing temperature in a small furnace because of its large size, which made torch heating difficult. The broken pieces were carefully cleaned, fluxed and "pretinned" with brazing alloy before assembling. When the silver brazing alloy melted at 1,175 F, the pieces settled neatly into place under pressure of their wrapping of nichrome wire.

A number of large broaches—one broken and the others repaired—are pictured in Fig. 3. Each is approximately 5 ft long and over 2 in. in diam. Prior to brazing, each broach was carefully lined up in a jig and torch heated. The brazing alloy completely wetted the joint area and made a high strength bond. Service records of repaired broaches indicate perfect performance throughout the normal life of the tool.

The repaired drill in Fig. 4 measures approximately 23 in. long by 3⅝ in. in diam and is made from high speed tool steel. It broke in two while drilling holes in the cast steel base of a hydraulic press. The two sections were ground to flat surfaces and carefully cleaned, fluxed and jigged in position. Several torches were used simultaneously in order to heat the drill rapidly and evenly to 1,175 F. Silver alloy wire was fed into the butt joint and was pulled by capillary attraction throughout the closely fitted joint area.

Fig. 4—This 23 in. high speed steel drill broke in two but was afterwards salvaged for further service.

Brazing High Speed Tips

The need for conserving high speed tool steel has aroused considerable interest in the use of HSS cutting tip inserts in carbon steel shanks. Two typical cutting tools with high speed tips brazed into recesses are shown in Fig. 5.

We are, of course, anxious to preserve the hardness of the high speed steel, which has probably been quenched from a high temperature and then drawn at approximately 1,050 F to a hardness of about 65 Rockwell C. Fortunately, it is possible to reheat tool steels so treated up to 1,200 F without lowering their Rockwell C hardnesses more than 2 to 5 points, provided the time while the steel is kept at 1,200 F is very short.

The brazing procedure is as follows:

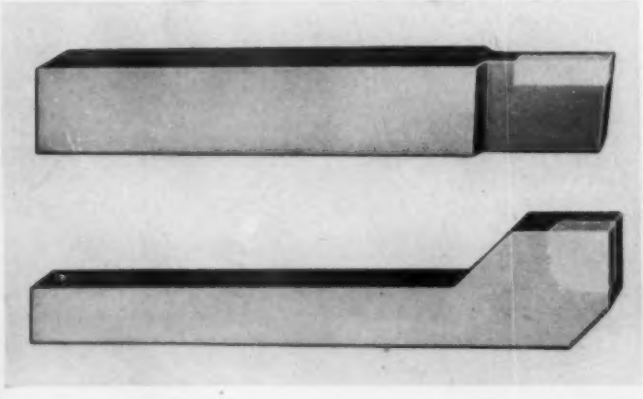
First, clean the joint surfaces of both tip and shank by either chemical or mechanical means. Be sure all joint surfaces are close fitting.

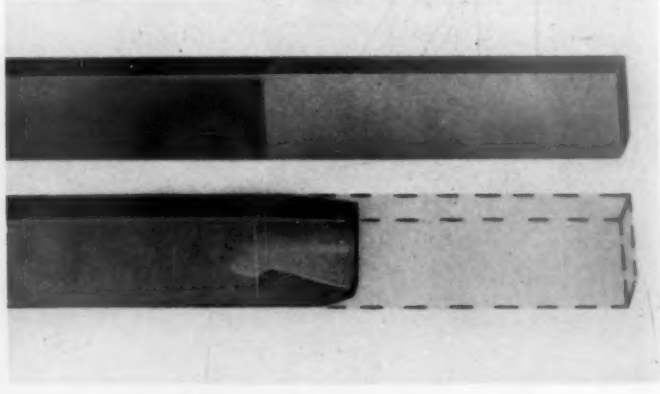
Second, coat all joint surfaces liberally with a silver brazing flux.

Third, apply the brazing alloy. Thin sheet inserts may be used as

Fig. 5—High speed cutting tool tips which have been brazed to recessed carbon steel shanks.

Fig. 6—High speed cobalt steel tool butt-brazed to a rolled steel shank. Even when the tool had been worn by use and many grindings, as shown below, no failure in the braze occurred.





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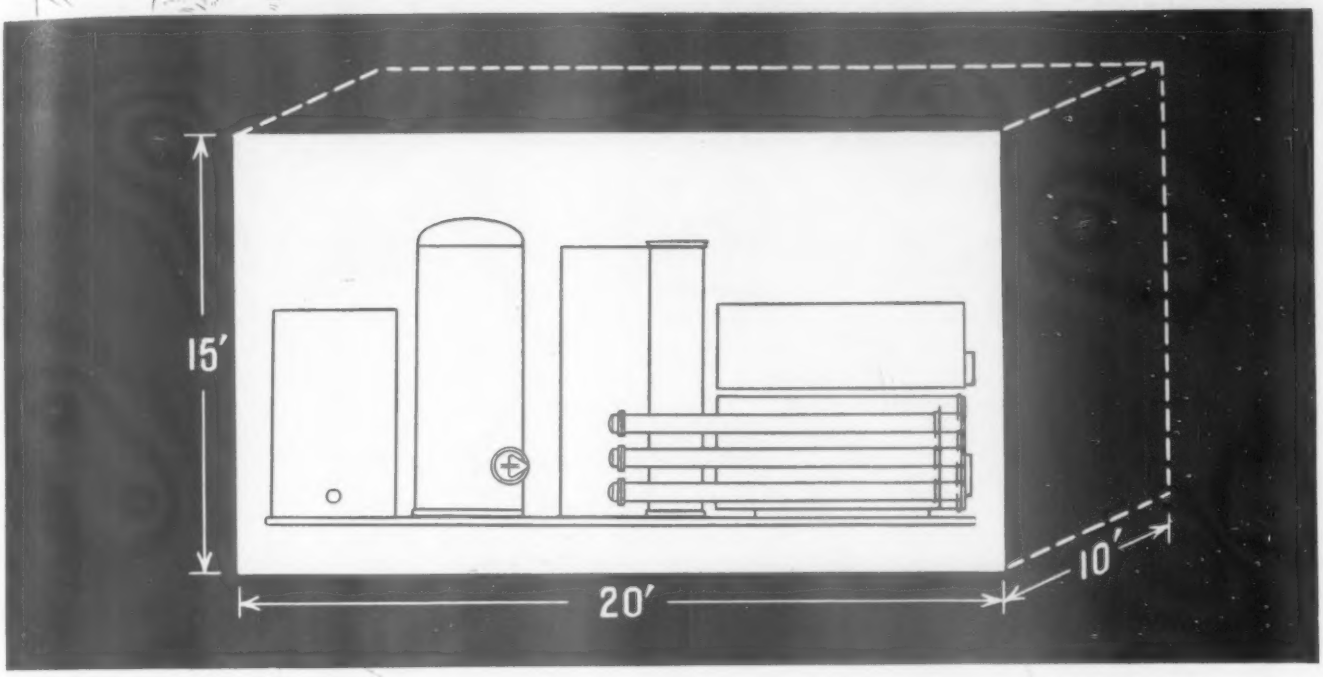

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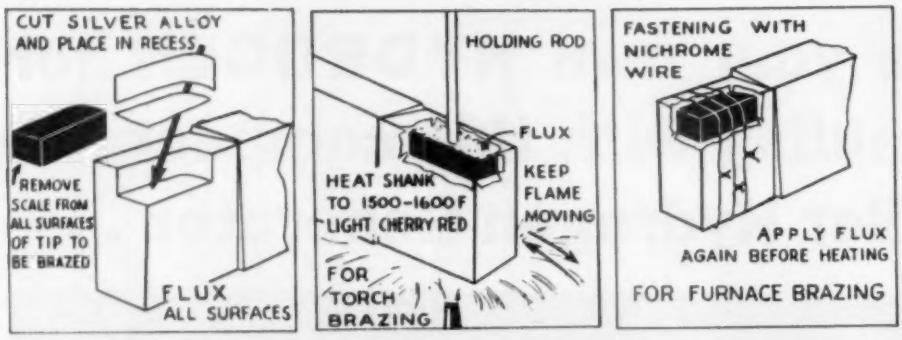

CUT SILVER ALLOY AND PLACE IN RECESS
REMOVE SCALE FROM ALL SURFACES OF TIP TO BE BRAZED
FLUX ALL SURFACES
HOLDING ROD
FLUX
HEAT SHANK TO 1500-1600 F LIGHT CHERRY RED
KEEP FLAME MOVING
FOR TORCH BRAZING
FASTENING WITH NICHROME WIRE
APPLY FLUX AGAIN BEFORE HEATING
FOR FURNACE BRAZING

Fig. 7—Steps in the silver brazing of cemented carbide cutting tool tips. A thin sheet of brazing alloy is cut to fit the recess of the shank as shown in the left diagram. The procedure for torch brazing and the method of preparation for furnace brazing are illustrated at center and right, respectively.

shown in Fig. 7. The preferred practice, however, is to apply the alloy by tinning all recessed surfaces of the carbon steel shank with wire. This is done by heating the underside of the shank to a temperature of about 1,200 F with an oxy-acetylene torch and allowing the wire to flow on the recessed shank surfaces.

Fourth, the fluxed tip is placed into position while the shank is hot. Since the cold tip will naturally chill and solidify the brazing alloy, the torch is again brought into play. The torch flame should be directed to the underside of the shank so that the heat will soak through the shank and heat the steel tip by conductivity. This heating method will prevent overheating of the tip. The proper brazing temperature is reached when the tool tip will slide around easily on the film of molten alloy.

Fifth, allow the alloy to solidify, holding the tip in place while applying a light pressure by means of tongs or a steel rod.

Sixth, shorten the period in the softening range by cooling to below the critical temperature of 1,050 F as rapidly as possible. This may be accomplished by using an air blast or an oil quench.

The necessity for a closer temperature control than in most brazing operations is the essential feature in successful brazing of high speed steel tips. Too low a temperature may make for a poor bond, while too high a temperature may substantially lower the tip hardness. Furnace heating is therefore unsuitable, inasmuch as in the furnace the time in the softening range of the steel would, in general, be too long.

Fig. 6 shows a high speed cobalt tip which was butt-brazed to a cold-rolled steel shank in order to save costly tool steel. After pretinning the shank with silver alloy wire, the previously outlined procedure was followed. Three months' use and many grindings wore the tool as shown in the lower illustration, but no failure in the braze occurred during use.

Cemented Carbide Tips

Hard carbide tool tips have been successfully brazed for years with silver alloy. It has been found that a brazing alloy melting at 1,270 F gives greater joint strength and is to be preferred over the regular alloy which melts at 1,175 F. The higher temperature alloy is recommended by leading manufacturers of cemented carbide tool tips for use on tools where cutting heats do not go beyond 1,000 F.

After the size of the tip and dimensions of the tool shank recess have been determined as recommended by carbide tip manufacturers, the brazing procedure follows this pattern:

First, be sure that all joint surfaces on both tip and recessed shank are clean. It is sound practice to touch the surfaces to be joined lightly against the flat face of a silicon carbide wheel until clean and then wipe thoroughly with carbon tetrachloride.

Second, liberally flux the recessed shank surfaces, the carbide tip and the brazing alloy with silver brazing flux.

Third, cut a thin sheet of alloy to fit into the recess as shown in Fig. 7 (left) or else "pretin" all surfaces of the recess as previously described for the brazing of high speed tool tips. Place the fluxed tip into position.

Fourth, apply torch heat to the underside of shank, as shown in Fig. 7 (center), so that the heat will soak up to the carbide tip. Use a holding rod to keep the tip in position. Keep the flame in constant motion in order to avoid hot spots, and do not apply it to the tip at any time.

Fifth, watch for the flux to become clear and liquid, indicating that brazing temperature has almost been reached. Just as soon as the tip can be moved on the molten film of alloy, withdraw the flame and exert a slight pressure on the holding rod to insure a strong bond. "Slight" really means slight, it should be noted.

Sixth, as soon as the brazing alloy has solidified, cool the tool slowly in powdered hard coal, asbestos, mica or lime in order to prevent cracking the tip during cooling. Do not cool tools with cemented carbide tips by air blasting or oil quenching.

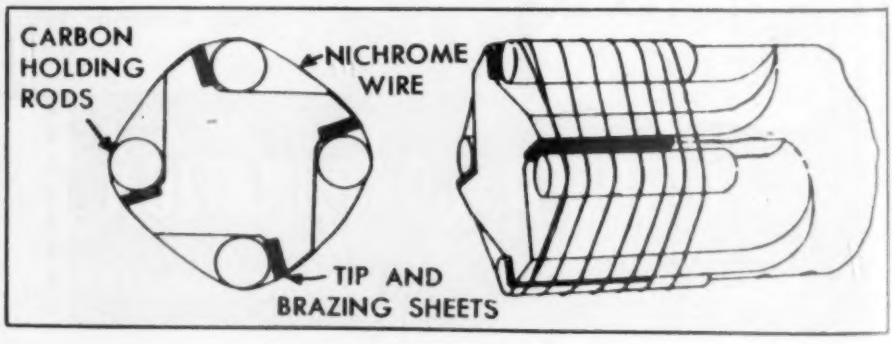
An alternate to torch heating is the use of a controlled atmosphere furnace or a closed type muffle furnace. For furnace brazing, the assembly is tightly wrapped with individual strands of nichrome wire as illustrated on the right of Fig. 7.

"Sandwich" Brazing

The procedure just given applies to cemented carbide tips under ¾ in. in width. For tips ¾ in. or larger and for irregularly shaped tips, the "sandwich" braze is recommended to reduce the brazing strains common to tips of larger size and irregular shape. The "sandwich" is made by using a thin sheet of constantan (40% nickel, 60% copper alloy) between two layers of the higher temperature silver alloy. In this case, it is desirable to heat the shank by applying the torch flame to the bottom and sides of the shank and finally to the tip itself in order to complete the braze.

Fig. 8 shows a brazing assembly for multi-point tools. This assembly is held in place with carbon holding rods and nichrome wire. Care should be taken in order to prevent burning the wire during brazing.

Fig. 8—Brazing multi-point tools. Carbon rods and nichrome wire are used to hold the assembly in place.



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Because Stainless Steel stands so high on the list of critical materials, it is more than ever necessary to see to it that the electrode you are able to get will give you the proper metal in the weld. And it becomes even more essential to see that you get electrodes of the proper diameter and that your men waste none of them.

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On the Job

Feeding a Multitude

REMEMBER the story of the loaves and fishes? Something like that Biblical problem confronted executives of R. G. LeTourneau, Inc., in planning for the dedication of their new plant at Vicksburg, Miss. An audience of 6,000 or so guests had to be fed a hot meal where and while they sat.

It was decided that the main dish would be tamale pie, which is a tasty concoction of ground beef, onions, corn meal, tomatoes, corn and Spanish pepper. But what pots would be big enough to cook the quantity needed to feed the hungry 6,000? Cooking pots of that colossal size simply weren't in existence.

Ingenuity and arc welding solved the problem by fabricating five 350 gallon pots from ¼ in. plate—four for cooking the tamale pie and one for brewing coffee. These giant vessels measured 30 in. wide, 112 in. long and 30 in. deep; the bottoms were rounded and a 6 in. rim encircled the tops.

Fire pits or ovens, each 43 in. tall and slightly wider and longer than the pots, were also welded from ¼ in. plate. These provided plenty of clearance for the fires.

A pair of dollies was provided for each pot. The front dolly was equipped with a handle and a vertical L-shaped projection which fitted into a channel at either end of the pot. For each pit, there was also made a table with braced legs fitting onto the four corners of the pot. These tables could be placed to ride atop the pots.

About 6 a.m., the four tamale pots were charged with their contents of 2,400 lb of ground beef, 600 lb of onions, 200 gallons of canned corn, 300 gallons of canned tomatoes, 600 lb of cornmeal, 30 lb of Spanish pepper, 90 lb of salt and 6 lb of black pepper. (This was, of course, before rationing.) The ingredients were allowed to simmer over red hot fires of sawed logs until the speaking program concluded.

At about 1 p.m., each pot was lifted from its stove onto the dollies. The tables were loaded with paper plates, spoons, butter and rolls, etc., and the combination trundled down the aisles. Each cart was kept moving while 12 waiters dispensed plates loaded with food.

Rarely if ever, the company believes, has so large a crowd been fed a steaming hot meal in so short a time.

» «

Aluminum Castings Salvaged

IMPERFECT aluminum castings are now being salvaged by means of the atomic-hydrogen arc welding process at the plant of an Ohio manufacturer, who is thus saving much time and critical material. Even though the repaired castings are subjected to a rigid X-ray inspection, their rejection rate has been less than 1% since the adoption of the atomic-hydrogen process.

Prior to making the welding repair, the castings are preheated in a furnace adjoining the welding booth. The welding is done by an operator who has passed the Air Corps qualification tests. Metal of exactly the same analysis as the base metal is deposited. The welds are ground flush with the casting surface, and it is then impossible to detect the weld outline in any way, even by X-ray inspection and physical testing.

Experience at this plant has shown that in nearly every case imperfect aluminum castings can be salvaged regardless of the size of the original imperfection. The company's investment in preheating and welding equipment was returned in less than three months.

Metal Cab Protection

By M. T. PATE

THE cab and rear glass of the trucks used for heavy hauling in the oil fields is protected by a steel framework—normally welded of heavy 2 in. pipe—to prevent the loads shifting against the cab. This frame provides a handy carrier for such truck gear as boomers, chain and load-binders. When hung over the framework, however, such items tend to swing against the cab—sometimes striking it with sufficient impact to cause damage and even to break out the safety glass.

Mesh support for the chains and hooks carried on oil field trucks. The equipment is kept entirely clear of the truck winch and is more readily kept in shape for instant use than when allowed to dangle freely from the carrying member.

The weldor for one trucking company improved on the frame by covering the upper surfaces of it with sections of heavy metal mesh. Tacked into place around the frame, the mesh provided a support which effectively supported chains and hooks yet did not interfere with the driver's view of his load.

One of the arc welded cooking pots constructed for serving hot tamale pie to 6,000 guests. The table fitted above the pot, which was placed on a pair of dollies and rolled to the diners.

Courtesy, The Hobart Brothers Co.

Atomic-hydrogen arc welding is used to repair imperfect aluminum castings. After the weld has been ground flush with the casting surface, even X-rays cannot detect it.

Courtesy, General Electric Co.

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FOR MORE AND FASTER WELDING...

...THE WILSON "BUMBLE BEE" AC WELDER

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This sturdy, efficient Wilson AC machine gives you three advantages that have unusual value today:

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2. It cuts power consumption—and costs—as much as 40%, because AC welders eliminate idling loss.
3. It simplifies maintenance because the "Bumble Bee" has no heavy rotating parts that need frequent attention.

Equally important – the "Bumble Bee" can be delivered faster than equivalent dc machines because it requires much less critical materials. Two sizes are available – 300 and 500 amperes. For full details write to Wilson Welder & Metals Co., Inc., 60 East 42nd Street, New York 17, N. Y.

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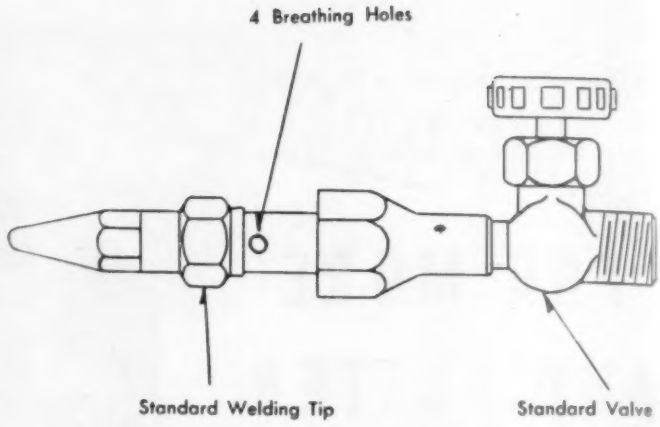
Duplex Brazing Torch

A DUPLEX soldering and brazing torch which permits the use of either hydrogen or acetylene with air was recently developed at the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co.

The accompanying sketch shows the construction of the torch when used with hydrogen. For conversion to acetylene, the injector head is removed and a longer injector head with holes of decreased diameter is screwed into place. A standard welding tip and valve body are used, as the sketch shows.

With acetylene, the flame temperature is approximately 4,250 F, but with hydrogen the temperature is lowered to approximately 3,700 F. This torch can be used for soldering operations requiring the use of lower melting point solders or for preheating on materials that would be injured by the 6,300 F temperature of an oxy-acetylene flame.



Torch suitable for either air-acetylene or air-hydrogen operation. To convert, it is only necessary to change injector head.

» «

Welding Weathers Storm

DURING a recent flood in New York state, the water swept through a ravine with such force that it carried away large sections of the soil around a 6 in. pipeline. Even though originally buried 4 ft underground, sections of the pipe were left suspended as high as 12 ft in the air after the flood waters had receded.

Courtesy, The Lincoln Electric Co.

Flood waters laid bare this section of a welded pipeline, but the joints remained intact even when bent 10 ft out of line.

Some pipe sections were bent out of line by as much as 10 ft, yet a close inspection revealed no failures in the welding. The welded joints were not only unbroken but remained leakproof throughout the entire length of the pipe.

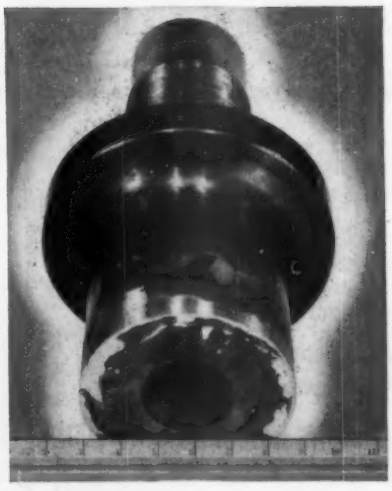
The expense and stoppage of service avoided can be appreciated by considering the damage that would have resulted if this line had broken. As it was, the welded joints were able to withstand the heavy stresses and strains to which they were subjected, and the maintenance crew had only to lower the pipe into a new ditch and cover it up again.

HOW A $25.00 HARD-FACING JOB

Saved a $150.00 punch replacement!

TO HAVE REPLACED this badly worn hot upsetting punch with a new punch would have cost $150.00! It also would have necessitated an unavoidable delay in waiting until the new punch had been delivered and installed.

Again Coast Metals Hard-Facing saved the day! By building the worn punch up to its original dimensions with an extra wear-resistant coating of Coast Metals, it was made good as new. In fact, *better than new* since it will now outwear and outlast a new punch several times! All at a cost of only $25.00!



CLOSE-UP of Hot Upsetting Punch, Showing Coast Metals Overlay After Rough Grinding.

Instead of sending *your* worn parts to the scrap pile, see first whether you cannot salvage them through Coast Metals Hard-Facing. Easily applied by the electric welding arc or oxy-acetylene torch, it is equally suitable both for new and old parts of any ferrous metal.

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COAST METALS *hard-facing weld rods*

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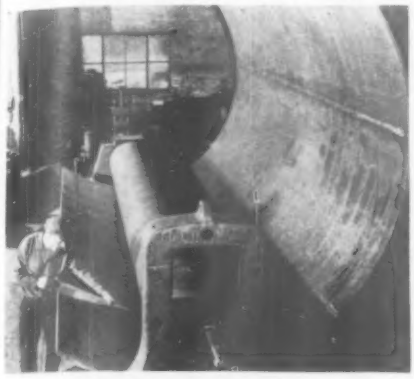
Making Big Plates

UNABLE to get single plates large enough for large motor-generator and turbine wrapper sheets, the Schenectady Works of General Electric Co. welded smaller sections of 1 in. plate together for this purpose. Ductile and accurately deposited welds which would without reinforcement equal the tensile strength of the original plate were required.



This large 1 in. plate was fabricated by welding four separate sections. The welds had to be ground flush with the plate surface and bend without cracking when the plate was given its proper curvature on these bending rolls.

The plate shown in the accompanying picture consists of four sections joined by three arc welded seams (only two are visible). The edges were flame-cut to provide a double-vee joint. Half the weld was deposited from one side. The plate was then turned over, the root of the first half of the weld was chipped out, and the second half of the weld was completed. After welding, the deposited metal was chipped flush with the plate so that the weld would pass smoothly through the bending rolls.

» «

Flame-Cut Gear Blanks

A LONG ISLAND builder of derricks and hoists needed a small quantity of gears for the driving mechanism of several large cranes. He turned logically to flame-cutting as the quickest method of making gear blanks 4 in. thick and 20 in. in diameter.

The blanks were cut from a large slab of medium carbon steel. Five piercing starts were required on each gear to provide the four lightening holes and the center shaft opening. The piercing was done with an oxygen lance after shallow craters in the center of each waste section had been routed out with a hand cutting torch.

After the holes had been burnt completely through with the lance, a flame-cutting machine of the pantograph type was employed for the subsequent cutting. This machine was equipped with a magnetic tracing head which followed the outlines of a steel template. The cutting speed was 7 in. per minute, in the 4 in. plate, and the quality of cut was said to be extremely good. The cuts were made with a tip having an oxygen-cutting orifice 0.096 in. in diameter and operating at an oxygen pressure of 55 psi and an acetylene pressure of 3 psi.

The gear hub was flame-cut in a separate operation and welded into place before the finished gear blank was sent to an outside shop for machining of the gear teeth.

» «

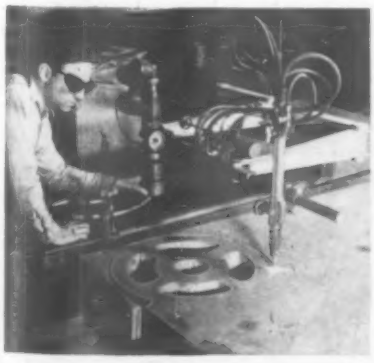
Pipe and Rod Carrier

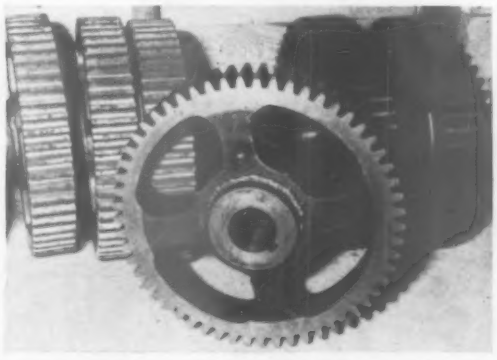
AN ALL-WELDED, motor-driven pipe and rod carrier developed by the Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O., permits the cab operator to pick up 1,500 lb of stock in 12 ft lengths from the storage room, transport it and set it in racks at fabricating machines without any floor men.

Since this unit travels overhead, its use eliminates the need for aisles and thus makes possible the saving of considerable floor area. One important war plant, for instance, found that 400 metal working machines could be installed and operated in only slightly larger space than that ordinarily required for 200 machines.

The rod and pipe are handled by two forks which are tilted upward when loading or downward when unloading by a motor-driven crank. A limit switch automatically stops the forks in the upward or holding position when the fork mechanism is not in operation. The hoisting speed is 20 fpm, and carrier travel speed is 300 fpm.

The pick-up fork assembly is of all-welded construction and has a 3-point rope suspension from an all-welded carrier, which gives it the necessary rigidity for handling loads far out of balance. The carrier travels on a double overhead track.





Courtesy, Air Reduction Sales Co.

Left: a magnetic tracer guides the torch, which is cutting a gear blank from 4 in. plate. On the right are completed gears after machining. Note the welded hubs.

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AN ALL-PURPOSE WELDER

Model WT-4C—200 amperes. 27 current settings from 20 to 250 amperes permit using a variety of electrodes. Easily moved. Built-in capacitor (optional). Nofuze "Deion" Circuit Breaker. Line voltage—220.

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Model WT-1C—100 amperes. 15 current settings from 20 to 140 amperes. Built-in capacitor (optional). Built-in breaker protection. Line voltage—220.

For latest literature, write Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., Dept. 7-N. J-90476

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A-C WELDERS

Refinery Fire Thwarted

WHEN fire partially destroyed the Westville, Ind., refinery, it looked like a major catastrophe. Several of the big storage tanks were twisted out of shape and had their tops blown off by explosions. Because of the war, it was impossible to replace these tanks with new ones.

Edward J. Lane, the refinery's weldor, was called upon to do what he could in the way of salvage. Equipped with a 300 amp arc welder that he had mounted on an old automobile chassis and powered with a gasoline engine, Mr. Lane went into the field to straighten the twisted tanks and put them back into shape for storage. And he was highly successful.

Courtesy, The Hobart Brothers Co.

The fire-damaged Westville, Ind., refinery was put back in operation for much needed petroleum products by salvaging storage tanks that looked like this.

The cost of straightening and welding the seams of the first twelve tanks salvaged was $375, including labor. These tanks held approximately 15,000 gallons each. New tanks of that capacity, had they been available, would have cost thousands of dollars.

» «

Air Cleaner Repair

By CHARLES C. LYNDE

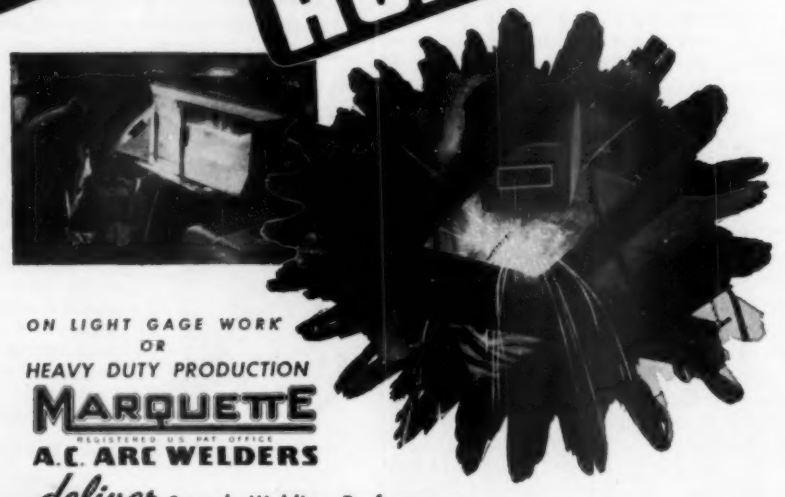
THE swinging hook on a truck snagged and wrecked the air cleaner for the compressor servicing a power station equipped with internal combustion engines. It appeared that the compressor would have to be run on the sand-laden air swirling around the building until a replacement could be located and installed. The plant weldor, however, noting the proximity of the air cleaner to the intake line of one of the big internal combustion engines, suggested an alternative which required but a few minutes to effect.

Emergency air cleaner repair. Three welds, one ell and a short length of pipe enabled the plant to continue properly equipped.

The drop piping on which the compressor cleaner had been supported was cut off, an ell welded in and a short length of pipe (the original support) was tied in to the riser above the big cleaner for the engine. The big engine was not even shut down. Instead, a clean-out cover in the air line near the unit was opened to let the suction draw air from within the station while the opening was being cut and the branch line tied into the big cleaner's riser. Thus one air cleaner serves both engine and compressor.

So well has this repair worked that to date the replacement cleaner for the compressor has never been ordered.

BUNT OR HOMERUN



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[above] Hard-surfacing caterpillar treads.

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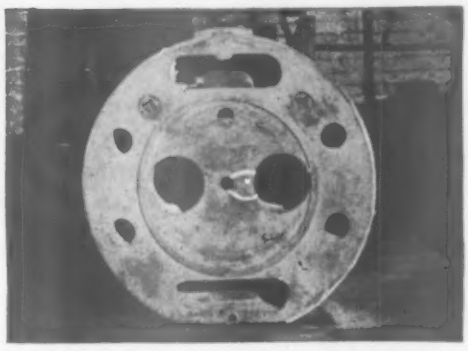
Why not write for a copy of the Meco Catalog now, so that you may anticipate your requirements of gas welding equipment? Shipments, based on priority, can be made immediately.



[above] Repair on 600 pound Diesel engine cylinder head.

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Do You Agree?

Welding Electrodes

Q—What is the difference between cellulosic and mineral type electrodes, and why are these two types of electrodes necessary?—*G.M.H.*

A—The term "cellulosic type" is applied to an electrode having a considerable portion of cellulose in its coating. This type of coating contains such ingredients as sodium silicate, alpha and beta cellulose, asbestos, ferromanganese and titanium dioxide. A considerable portion of this material burns out to form a gas in the arc. This type of electrode is suitable for operation on D-C, reverse polarity only, though it may be used as an all-position electrode.

The mineral type of electrode coating contains sodium silicate, ferromanganese, iron oxide, silica or quartz and a small quantity of alpha cellulose. This type of electrode may be used on either A-C or D-C welding operations. Use of the mineral type coating is generally confined to electrodes designed for horizontal or flat welding. The coating is of material that will form an abundance of slag, providing ample coverage and complete shielding.

A mineral coating high in titanium dioxide will produce an electrode suitable for general purpose operation in either D-C, straight polarity, or A-C welding applications.

» «

Cemented Carbides

Q—What is the tool-tipping material which is sold as Carboloy? Will it fuse well to other base metals?—*C.B.*

A—Carboloy or other tool-tipping materials sold under various trade names are cemented carbide compounds. They contain tungsten, titanium, tantalum, carbon and other tough, high-melting-point materials. Cemented carbide bits are made from these materials by powdered metallurgy. The ingredients are crushed and ground until very fine, and heat and pressure are then applied. The resulting powder is thus caused to sinter into a material of high hardness. The powder does not melt at any time during the process.

Since the materials in cemented carbides cannot be melted at ordinary temperatures, it is impossible to weld or fuse them to base metals. The recommended procedure of attaching cemented carbide tool tips is by the use of silver brazing. The sintered carbide tip is not heated greatly in this application and, consequently, will not crack. If an attempt is made to weld cemented carbides by either arc or gas, uneven expansion of the material would undoubtedly result in the carbide cracking and chipping off before the weld was completed.

» «

Fire Brick

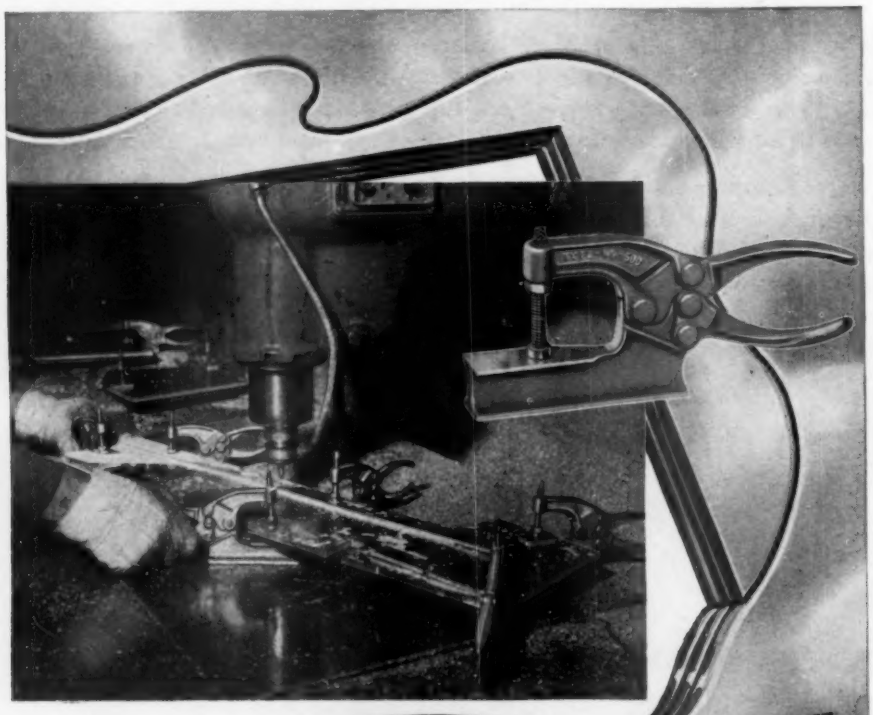
Q—I am thinking of building an oil forge furnace and would like to know what type of brick should be used? Would common fire brick be satisfactory?—*O.M.*

A—In constructing a furnace of this type it would be well to use a first-grade fire brick laid on edge in the bottom of the furnace with the ends exposed to the heat and the walls. The brick should be backed up with a full 9 in. wall of not less than second-grade fire brick in both bottom and walls.

Brick used in furnace construction should be stored in a dry place free from moisture, either from dampness or due to cold. The furnace should also be thoroughly dried out by use of a mild fire before it is brought up to heat. To help in the selection of the proper brick, the following melting points of various bricks are given:

First-grade common fire brick	2,830 to 3,140 F.
Bauxite fire brick	2,950 to 3,250 F.
Silica fire brick	3,095 F.
Chromite fire brick	3,720 F.
Magnesia brick	4,950 F.

If you, as a reader, do not agree with our answers, let us know your thoughts. Your comments and discussions will be published, too.



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KNU-VISE PLIERS

MODEL KL-500

With the lower jaw shaped like an anvil, these pliers can securely hold a stack of metal sheets together for routing operations. The top and base are wide and flat (ground within .001 inch in accuracy), and enable operator to steer work around with great ease.

Let us tell you how we are helping manufacturers simplify operations where clamping is involved.

BUY WAR BONDS

KNU-VISE INCORPORATED

1336 PLUM STREET DETROIT, MICH.

4328 SAN FERNANDO RD. GLENDALE, CALIF.

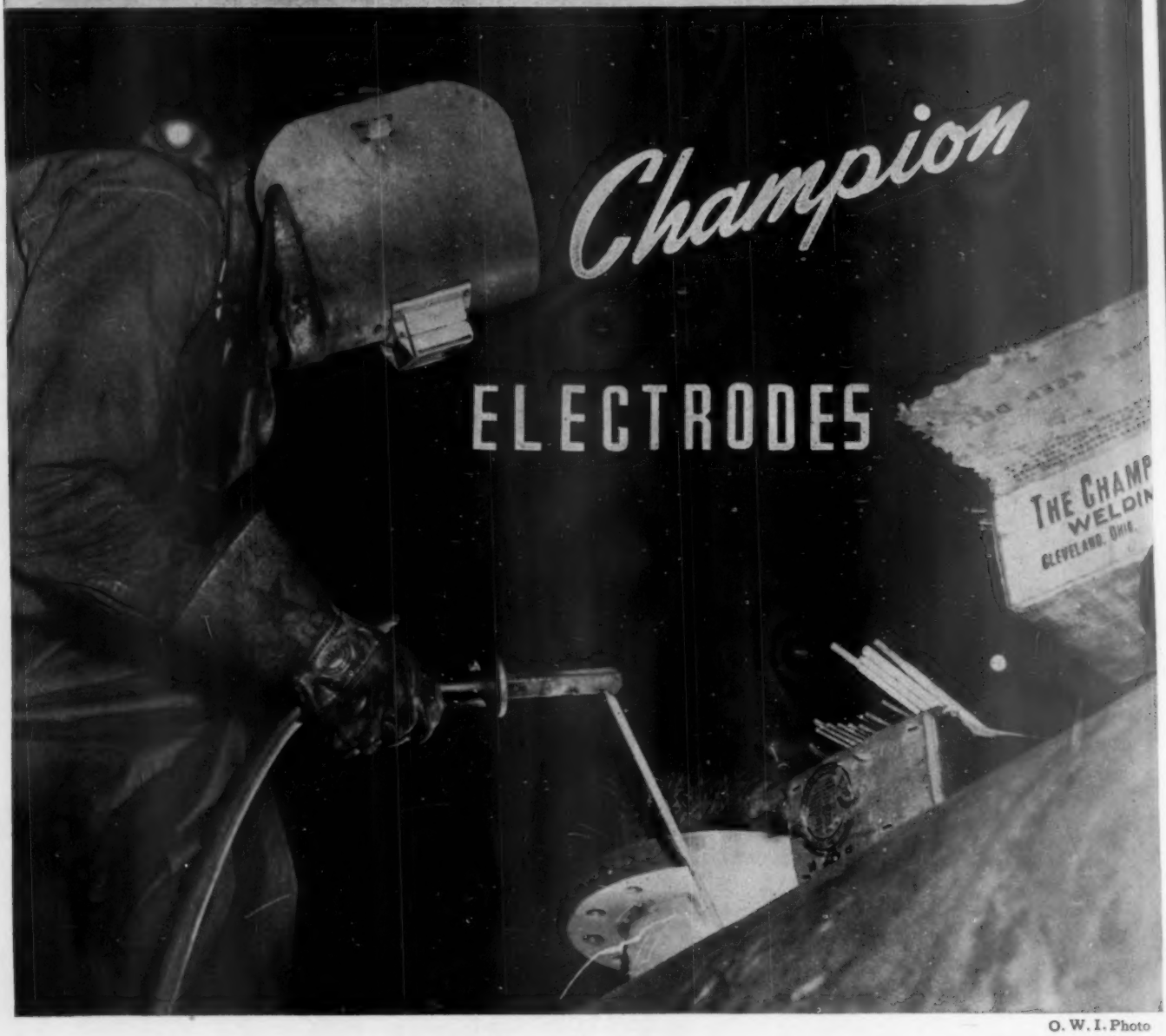
Temperature Conversion Tables

TEMPERATURE CONVERSION TABLES*

−459.4 to 0			0 to 100				100 to 1000				1000 to 2000				2000 to 3000			
C	F		C	F		C	F		C	F		C	F		C	F		C	F
−273	−459.4		−17.8	0	32	10.0	50	122.0	38	100	212	260	500	932	538	1000	1832	816	1500	2732	1093	2000	3632	1371	2500	4532
−268	−450		−17.2	1	33.8	10.6	51	123.8	43	110	230	266	510	950	543	1010	1850	821	1510	2750	1099	2010	3650	1377	2510	4550
−262	−440		−16.7	2	35.6	11.1	52	125.6	49	120	248	271	520	968	549	1020	1868	827	1520	2768	1104	2020	3668	1382	2520	4568
−257	−430		−16.1	3	37.4	11.7	53	127.4	54	130	266	277	530	986	554	1030	1886	832	1530	2786	1110	2030	3686	1388	2530	4586
−251	−420		−15.6	4	39.2	12.2	54	129.2	60	140	284	282	540	1004	560	1040	1904	838	1540	2804	1116	2040	3704	1393	2540	4604
−246	−410		−15.0	5	41.0	12.8	55	131.0	66	150	302	288	550	1022	565	1050	1922	843	1550	2822	1121	2050	3722	1399	2550	4622
−240	−400		−14.4	6	42.8	13.3	56	132.8	71	160	320	293	560	1040	571	1060	1940	849	1560	2840	1127	2060	3740	1404	2560	4640
−234	−390		−13.9	7	44.6	13.9	57	134.6	77	170	338	299	570	1058	577	1070	1958	854	1570	2858	1132	2070	3758	1410	2570	4658
−229	−380		−13.3	8	46.4	14.4	58	136.4	82	180	356	304	580	1076	582	1080	1976	860	1580	2876	1138	2080	3776	1416	2580	4676
−223	−370		−12.8	9	48.2	15.0	59	138.2	88	190	374	310	590	1094	588	1090	1994	866	1590	2894	1143	2090	3794	1421	2590	4694
−218	−360		−12.2	10	50.0	15.6	60	140.0	93	200	392	316	600	1112	593	1100	2012	871	1600	2912	1149	2100	3812	1427	2600	4712
−212	−350		−11.7	11	51.8	16.1	61	141.8	99	210	410	321	610	1130	599	1110	2030	877	1610	2930	1154	2110	3830	1432	2610	4730
−207	−340		−11.1	12	53.6	16.7	62	143.6	100	212	413.6	327	620	1148	604	1120	2048	882	1620	2948	1160	2120	3848	1438	2620	4748
−201	−330		−10.6	13	55.4	17.2	63	145.4	104	220	428	332	630	1166	610	1130	2066	888	1630	2966	1166	2130	3866	1443	2630	4766
−196	−320		−10.0	14	57.2	17.8	64	147.2	110	230	446	338	640	1184	616	1140	2084	893	1640	2984	1171	2140	3884	1449	2640	4784
−190	−310		− 9.4	15	59.0	18.3	65	149.0	116	240	464	343	650	1202	621	1150	2102	899	1650	3002	1177	2150	3902	1454	2650	4802
−184	−300		− 8.9	16	60.8	18.9	66	150.8	121	250	482	349	660	1220	627	1160	2120	904	1660	3020	1182	2160	3920	1460	2660	4820
−179	−290		− 8.3	17	62.6	19.4	67	152.6	127	260	500	354	670	1238	632	1170	2138	910	1670	3038	1188	2170	3938	1466	2670	4838
−173	−280		− 7.8	18	64.4	20.0	68	154.4	132	270	518	360	680	1256	638	1180	2156	916	1680	3056	1193	2180	3956	1471	2680	4856
−169	−273	−459.4	− 7.2	19	66.2	20.6	69	156.2	138	280	536	366	690	1274	643	1190	2174	921	1690	3074	1199	2190	3974	1477	2690	4874
−168	−270		− 6.7	20	68.0	21.1	70	158.0	143	290	554	371	700	1292	649	1200	2192	927	1700	3092	1204	2200	3992	1482	2700	4892
−162	−260	−454	− 6.1	21	69.8	21.7	71	159.8	149	300	572	377	710	1310	654	1210	2210	932	1710	3110	1210	2210	4010	1488	2710	4910
−157	−250	−436	− 5.6	22	71.6	22.2	72	161.6	154	310	590	382	720	1328	660	1220	2228	938	1720	3128	1216	2220	4028	1493	2720	4928
−151	−240	−418	− 5.0	23	73.4	22.8	73	163.4	160	320	608	388	730	1346	666	1230	2246	943	1730	3146	1221	2230	4046	1499	2730	4946
−146	−230	−400	− 4.4	24	75.2	23.3	74	165.2	166	330	626	393	740	1364	671	1240	2264	949	1740	3164	1227	2240	4064	1504	2740	4964
−140	−220	−382	− 3.9	25	77.0	23.9	75	167.0	171	340	644	399	750	1382	677	1250	2282	954	1750	3182	1232	2250	4082	1510	2750	4982
−134	−210	−364	− 3.3	26	78.8	24.4	76	168.8	177	350	662	404	760	1400	682	1260	2300	960	1760	3200	1238	2260	4100	1516	2760	5000
−129	−200	−328	− 2.8	27	80.6	25.0	77	170.6	182	360	680	410	770	1418	688	1270	2318	966	1770	3218	1243	2270	4118	1521	2770	5018
−123	−190	−310	− 2.2	28	82.4	25.6	78	172.4	188	370	698	416	780	1436	693	1280	2336	971	1780	3236	1249	2280	4136	1527	2780	5036
−118	−180	−292	− 1.7	29	84.2	26.1	79	174.2	193	380	716	421	790	1454	699	1290	2354	977	1790	3254	1254	2290	4154	1532	2790	5054
−112	−170	−274	− 1.1	30	86.0	26.7	80	176.0	199	390	734	427	800	1472	704	1300	2372	982	1800	3272	1260	2300	4172	1538	2800	5072
−107	−160	−256	− 0.6	31	87.8	27.2	81	177.8	204	400	752	432	810	1490	710	1310	2390	988	1810	3290	1266	2310	4190	1543	2810	5090
−101	−150	−238	0.0	32	89.6	27.8	82	179.6	210	410	770	438	820	1508	716	1320	2408	993	1820	3308	1271	2320	4208	1549	2820	5108
− 96	−140	−220	0.6	33	91.4	28.3	83	181.4	216	420	788	443	830	1526	721	1330	2426	999	1830	3326	1277	2330	4226	1554	2830	5126
− 90	−130	−202	1.1	34	93.2	28.9	84	183.2	221	430	806	449	840	1544	727	1340	2444	1004	1840	3344	1282	2340	4244	1560	2840	5144
− 84	−120	−184	1.7	35	95.0	29.4	85	185.0	227	440	824	454	850	1562	732	1350	2462	1010	1850	3362	1288	2350	4262	1566	2850	5162
− 79	−110	−166	2.2	36	96.8	30.0	86	186.8	232	450	842	460	860	1580	738	1360	2480	1016	1860	3380	1293	2360	4280	1571	2860	5180
− 73	−100	−148	2.8	37	98.6	30.6	87	188.6	238	460	860	466	870	1598	743	1370	2498	1021	1870	3398	1299	2370	4298	1577	2870	5198
− 68	− 90	−130	3.3	38	100.4	31.1	88	190.4	243	470	878	471	880	1616	749	1380	2516	1027	1880	3416	1304	2380	4316	1582	2880	5216
− 62	− 80	−112	3.9	39	102.2	31.7	89	192.2	249	480	896	477	890	1634	754	1390	2534	1032	1890	3434	1310	2390	4334	1588	2890	5234
− 57	− 70	− 94	4.4	40	104.0	32.2	90	194.0	254	490	914	482	900	1652	760	1400	2552	1038	1900	3452	1316	2400	4352	1593	2900	5252
− 51	− 60	− 76	5.0	41	105.8	32.8	91	195.8				488	910	1670	766	1410	2570	1043	1910	3470	1321	2410	4370	1599	2910	5270
− 46	− 50	− 58	5.6	42	107.6	33.3	92	197.6				493	920	1688	771	1420	2588	1049	1920	3488	1327	2420	4388	1604	2920	5288
− 40	− 40	− 40	6.1	43	109.4	33.9	93	199.4				499	930	1706	777	1430	2606	1054	1930	3506	1332	2430	4406	1610	2930	5306
− 34	− 30	− 22	6.7	44	111.2	34.4	94	201.2				504	940	1724	782	1440	2624	1060	1940	3524	1338	2440	4424	1616	2940	5324
− 29	− 20	− 4	7.2	45	113.0	35.0	95	203.0				510	950	1742	788	1450	2642	1066	1950	3542	1343	2450	4442	1621	2950	5342
− 23	− 10	14	7.8	46	114.8	35.6	96	204.8				516	960	1760	793	1460	2660	1071	1960	3560	1349	2460	4460	1627	2960	5360
− 17.8	0	32	8.3	47	116.6	36.1	97	206.6				521	970	1778	799	1470	2678	1077	1970	3578	1354	2470	4478	1632	2970	5378
			8.9	48	118.4	36.7	98	208.4				527	980	1796	804	1480	2696	1082	1980	3596	1360	2480	4496	1638	2980	5396
			9.4	49	120.2	37.2	99	210.2				532	990	1814	810	1490	2714	1088	1990	3614	1366	2490	4514	1643	2990	5414
						37.8	100	212.0				538	1000	1832				1093	2000	3632				1649	3000	5432

* Look up reading in middle column. If in degrees Centigrade, read Fahrenheit equivalent in right hand column; if in Fahrenheit degrees, read Centigrade equivalent in left hand column.

For Champion Production·····CHOOSE



O. W. I. Photo

When exceptionally high quality of welds is required such as in the case of the boiler drums for our Merchant Fleet, Champion Red Devil "75" electrodes are usually employed. They produce sound, clean welds of high quality. The alloying elements in the coating impart high resistance to fatigue and heat.

"Be sure it's a stub before it's thrown away."

Photo Shows Champion Red Devil "75" electrode being used on a marine boiler drum in a large mid-west plant.

RED DEVIL • BLUE DEVIL • BLACK DEVIL • GRAY DEVIL

THE CHAMPION RIVET COMPANY

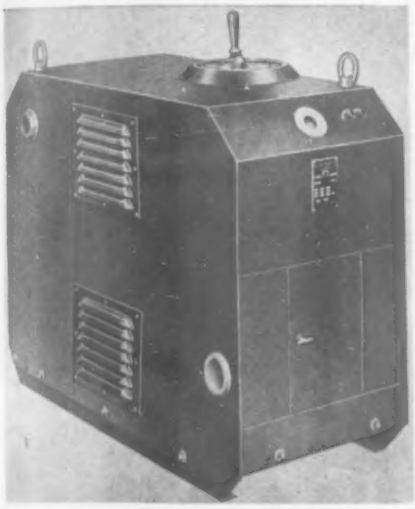
11400 HARVARD AVENUE — CLEVELAND, OHIO

EAST CHICAGO, INDIANA

New Products to Use

A-C Welder

★ **G-R Model 49** is a heavy-duty transformer-type A-C welder that is definitely a "war baby" in that it was especially engineered for the grueling service demanded by the 24-hour-day, 7-day-week schedules of war plants. Though manually operated, it can be converted to automatic operation when desired.



G-R Model 49. A heavy-duty A-C arc welder designed to meet the requirements of continuous service in war production plants.

Model 49 was designed and constructed with a large extra margin of safety to handle continuous welding loads. For this purpose, an oversized core working at low flux densities is incorporated. Two open circuit voltages give a wide variety of applications (particularly for the welding of heavy plate) within the output range of 100 to 675 amp. Amperage is adjusted by twisting the hand wheel and may be quickly varied to handle electrodes of from ⅛ to ⅜ in. diameter.

This welder is said to remain extremely cool at work, meeting the NEMA temperature rise specifications even without its forced ventilation system in operation. Forced ventilation, however, is standard equipment for extra coolness. **Glenn-Roberts Co.**, 1009 Fruitvale Ave., Oakland, Calif.

» «

Stainless Steel Flux

★ **Solar Flux No. 16GH** has been developed for the specialized welding of thin gauge strips, sheets, tubes, etc. of stainless steel and other high alloy chromium-bearing metals. This flux is characterized by an adhesive quality desirable for application to the underside and edges of metal, by a high melting point and by the protection it provides against oxidation. It qualifies under appropriate Army and Navy specifications, states manufacturer, and can be used with most welding processes including oxy-acetylene, metal arc, atomic hydrogen arc and Heliarc. It may be applied to metals several hours before the actual welding operation, will stick without the use of shellac and hold fast despite frequent handling.

No. 16GH flux in powdered form is available in 1 lb, 5 lb and 25 lb containers. A companion flux, Solar Flux No. 16, having a higher melting point, has also been developed. Use of the latter, however, is recommended only after trial of the No. 16GH flux. **Solar Aircraft Co.**, Dept. SF-23, San Diego 12, Calif.

» «

Burn Remedy

★ **Cofen** is a greaseless burn dressing derived from coal tar products, basic formula of which was used as far back as 1937 in treating the severely burned crew of the dirigible *Hindenburg* when it crashed at Lakehurst, New Jersey. Applied to a burn, Cofen will at once lessen

A useful bottle for the first-aid treatment of burns in the welding shop. Cofen can also be used for the treatment of minor bruises, cuts, etc.

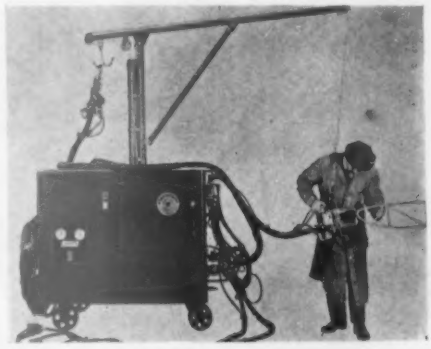
or stop the pain and will, moreover, act as an antiseptic and germicide and thus minimize the risk of infection during the time which elapses before the victim is able to see a physician.

The serious symptoms and complications that often accompany burns are caused, largely, by toxic absorption from broken-down protein products in the burned tissues. It is the aim of the external treatment, manufacturer explains, to prevent the toxic poison from entering the system and to remove the products of tissue degradation from the affected burn area. **Lee-Wood, Inc.**, South Norwalk, Conn.

Spot-Weld Repair Cart

★ A self-contained field cart for the repair spot welding of steel airplane parts has been developed by the **Progressive Welder Co.**, Detroit 12. It is said to permit practically any kind of spot welding job on stainless and other light gauge steels to be performed in the field.

The cart is equipped with an electronic



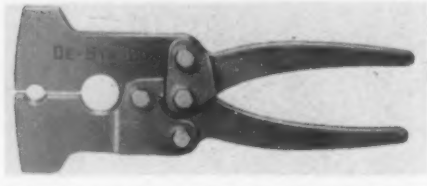
Cart for refrigerated spot welding on the airplane landing field.

timer and with a selection of both air-operated and manual "tong" type guns—all so designed that a large variety of differently shaped electrodes can be mounted in them. A refrigerating unit circulates a low-temperature coolant through transformer, cables and guns, thus eliminating the need for external water connections. The cart, which requires only a power lead to permit operation, is provided with long cables so that the power connection may be made in a hangar while welding repairs are being made far out on the landing field.

» «

Toggle Pliers

★ Pliers designed to do the difficult job of holding piping, tubes, rods or other

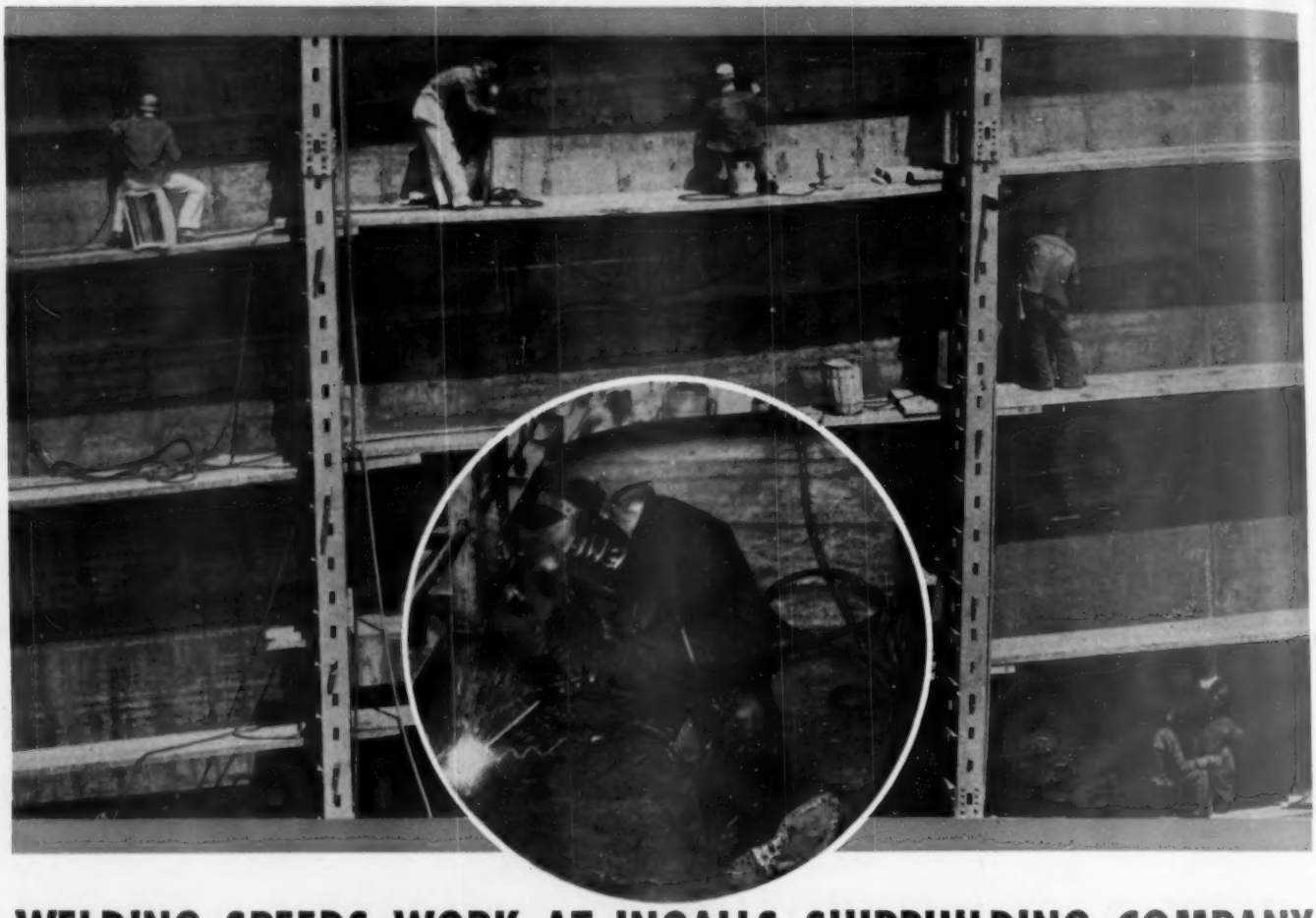


De-Sta-Co toggle pliers No. 455 for holding cylindrical objects of from ½ in. to 1¼ in. OD.

cylindrical parts have been brought out by the **Detroit Stamping Co.**, 372 Midland Ave., Detroit. These pliers lock into position and hold securely at any point within their gripping range but are easily and quickly released. The model illustrated, **No. 455,** will hold any cylindrical object from ½ in. to 1¼ in. OD. For larger sizes, the pliers may be bored and slotted to order, to fit user's requirements.

With miles of WELDING to do

—YOU CAN'T SPARE THE WELDING CABLE



WELDING SPEEDS WORK AT INGALLS SHIPBUILDING COMPANY

Photos courtesy Ingalls Shipbuilding Co., Pascagoula, Miss.

—another place where Belden Wire Goes to WAR

More ships are coming down the ways these days, thanks to new and better tools and American ingenuity. Welding is playing a most important part in this program . . . and Belden Welding Cables have made an important contribution. Their great flexibility makes welding operations easier — reduces fatigue of welders on the job. Tough Belden cable insulation stands up in service over hot steel plates for longer cable life and less time lost for replacements.

Belden Manufacturing Company
4677-A W. Van Buren Street
Chicago 44, Illinois

Belden
Welding **CABLE**

Awarded the U. S. Treasury Special Citation of * Merit for initiating the War Bond-or-Cash Dividend Plan

Magnetic Clamps

★ The **Sweetland magnetic clamp** was designed for shipyards but is applicable to other uses. The usual difficulties of lifting and transporting heavy magnets are eliminated by compact and relatively lightweight construction in comparison to holding power. Movement is further facilitated by retractable ball-bearing wheels working on a ball-bearing swivel.

Sweetland magnetic clamp for holding heavy ship members in position for tack welding.

Stiffeners are positioned and held in place for tack welding without the use of saddles, clips or other means requiring temporary welds. For fairing deck plates, one magnet is placed across the seam to bring the plates to the same level. With warped plates, a single magnet used in conjunction with a Johnson bar quickly effects leveling.

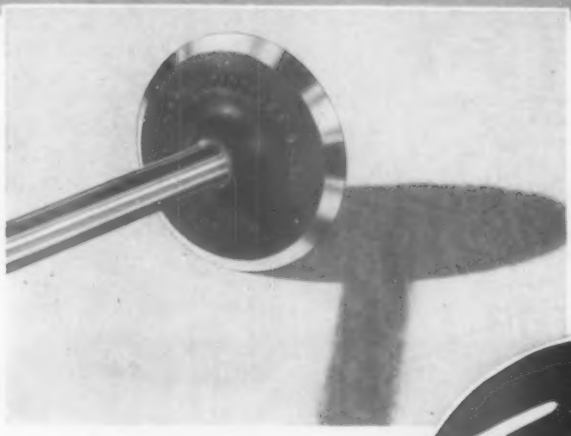
The device is available in three models: B, C and HVC. Models B and C comprise two-magnet units coupled together with a yoke carrying a handwheel and pressure screw to provide vertical and horizontal adjustments. Model B is composed of two 2-section magnets, exerts a pull of 3½ tons on ½ in. plate and weighs 210 lb. Model C utilizes two 3-section magnets, exerts a pull of 4½ to 5 tons on ½ in. plate and weighs 300 lb. Model B is adapted for stiffeners 8 in. high or less, and Model C for girders up to 18 in. The third model, HVC, is composed of a 3-section horizontal magnet and a 1-section vertical magnet to hold the stiffener rigidly in place and in a true 90 deg position. This model is furnished with a Johnson bar.

The clamp may be operated from the power supply of a motor-generator welding set or from any 80 volt direct current. A 12 amp rectifier of this manufacture is also available to supply D-C power from an A-C circuit. **Glenn-Roberts Co.**, 1009 Fruitvale Ave., Oakland, Calif.

Skin Cream

★ **Tarbonis** cream, a modified tar product, is said to be a specific for various skin disorders. The cream is greaseless, non-allergic and non-irritating. **The Tarbonis Co.**, 1220 Huron Road, Cleveland.

DIESEL VALVES
On Combat Ships



Diesel engine valves and seats faced with this hard, tough, heat-resisting alloy enable marine engines to deliver uninterrupted heavy duty service to allied combat vessels.

In the motor transport service, too, RESISTO-LOY gives diesels the endurance necessary for continuous performance under the heat and the pounding of a heavily laden carrier.

Tough ENOUGH TO TAKE IT WITH RESISTO-LOY

High pressure steam valve seats and valve faces treated with RESISTO-LOY are able to withstand terrific punishment. Deposits will not wash out, undercut or corrode.

When subjected to the severest heavy duty service on diesel engine valves and seats, RESISTO-LOY deposits will not score, spawl or shatter. At temperatures above 1000 degrees F even, they can be relied on for unmatched service. Get RESISTO-LOY AT THE NEAREST DISTRIBUTOR BELOW.

CALIFORNIA—Yonkers & Johnson, SO. DOS PALOS
FLORIDA—Welding Engineering Co., MIAMI
INDIANA—Purity Cylinder Gases, Inc., WARSAW
KANSAS—R. T. Brown Co., Ltd., SALINA
LOUISIANA—Woodward, Wight & Co., NEW ORLEANS
MAINE—Brown-Wales Co., LEWISTON
MARYLAND—Southern Oxygen Co., HYATTSVILLE and BALTIMORE
MASSACHUSETTS—Brown-Wales Co., BOSTON
MICHIGAN—Welding Metals & Mfg. Co., DETROIT
MICHIGAN—Purity Cylinder Gases, Inc., GRAND RAPIDS, KALAMAZOO and LANSING
MISSISSIPPI—J. E. Dilworth Co., VICKSBURG
MISSOURI—Puritan Compressed Gas Corp., KANSAS CITY
MISSOURI—Ross-Frazer Iron Co., ST. JOSEPH
OHIO—Universal Power Co., CLEVELAND
OKLAHOMA—Big Three Welding Equipment Co., TULSA and OKLAHOMA CITY
OREGON—Industrial Air Products Corp., PORTLAND
PENNSYLVANIA—Arcway Equipment Co., PHILADELPHIA and PITTSBURGH
PENNSYLVANIA—Shop Supply Co., PITTSBURGH
TENNESSEE—J. E. Dilworth Co., MEMPHIS
TENNESSEE—Southern Oxygen Co., KINGSPORT
TEXAS—Big Three Welding Equipment Co., FORT WORTH, HOUSTON, EL PASO, SAN ANTONIO and AMARILLO
TEXAS—Corpus Christi Oxygen Co., CORPUS CHRISTI and McALLEN
VIRGINIA—Southern Oxygen Co., RICHMOND
WASHINGTON, D. C.—Southern Oxygen Co.

Resisto-Loy COMPANY GRAND RAPIDS, MICHIGAN

Insulator replacements—molded plastic insulators to keep electrode holders on the job without factory maintenance.

Replacement Insulators

★ Lightweight molded plastic insulators for electrode holders are being offered by the **Rasmussen Iron Works,** 308 West Philadelphia St., Whittier, Calif. These insulators are supplied for use on tips and rod grips and as handles and cups. They are molded to the exact shape for quick installation on the three most commonly used sizes of popular-make electrode holders.

» «

Hard-Facing Alloys

★ **Stoody 1** and **Stoody 6,** two new hard-facing alloys of cobalt, chromium and tungsten, are now being furnished as oxy-acetylene welding rods. Stoody 1, the harder of the two alloys, provides high resistance to abrasion, corrosion and heat. It is recommended for pump sleeves, wood saw teeth, carbon scrapers, wire guides, expeller parts and similar applications.

Stoody 1 and 6 are two new hard-facing rods for application by the oxy-acetylene process.

Stoody 6 is not quite so hard as Stoody 1 but is more ductile and provides greater resistance to impact. It is used for hard-facing various types of valves, dies, shear blades, cams, etc.

Both rods are supplied in 1/8, 3/16, 5/16 and 3/8 in. diameters. **Stoody Co.,** Whittier, Calif.

» «

Cable Taper

★ To tape a comparatively long cable (or plurality of cables into a single unit) at a point where standard factory taping equipment cannot be used, a new portable cable tape winder has been developed.

Smith portable cable tape winder. It produces a factory-finished job where heretofore only hand taping has been possible.

This new tool, without power in itself, is used with a standard portable electric drill. A small drive pulley is mounted in the chuck of the drill, and a belt from this pulley drives the cable taping mechanism, which operates according to the operator's grip on the drill trigger. The operator merely holds the handle of the drill in one hand and the handle of the taper in the other and thus accurately performs what would be a slow and expensive operation if done by hand. The taper is said to be easily adaptable to different size cables and to be of particular value in shipbuilding, where many cable taping operations are now being performed by hand on the job. **Leathem D. Smith Shipbuilding Co.,** Sturgeon Bay, Wis.

MANGANAL

(Reg. U. S. Pat. Office. U. S. Patents 1,876,738—1,947,167—2,021,945)

11 to 13½% Manganese Nickel Steel

WELDING PRODUCTS

★ CAST WEDGE BARS ★

FOR REPOINTING MANGANESE AND CARBON STEEL SHOVEL AND DIPPER TEETH.

At Left—Cast Wedge Bar attached to worn down Dipper Teeth.

THE LARGER THE TEETH THE MORE YOU SAVE

At Right—Cast Wedge Bar attached to cutting edge of Dredge Cutter. Use Manganal Bare or Special Tite-Kote for attaching Cast Wedge Bar.

150 Distributors Are Ready to Serve You

Sole Producers

STULZ-SICKLES COMPANY

134-142 Lafayette St., Newark, N. J.

Try Seaco Hard Surfacing Over Manganal Weld Deposits

"Eye Savers." These goggles are featured by a glare filter which may be snapped in for welding or out for general service.

Welding Goggles

★ **"Eye Savers"** are lightweight (1¾ oz), all-plastic safety goggles with snap-in glare filter; they are convertible at an instant from welding to general utility by snapping out the filter and may be as quickly converted back again to welding service. Lenses are of high-priority "Plexiglas" that will not shatter under impact and resists the pitting caused by hot sparks. The goggle fits directly over prescription glasses, and its full frame gives protection against eye injury from the sides, top or bottom. **Watchemoket Optical Co.**, Providence, R. I.

» «

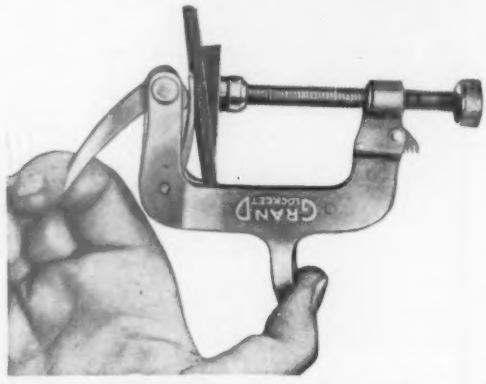
Welding Clamps

★ Three new lines of clamps have just been announced by **Grand Specialties Co.**, 3101 W. Grand Ave., Chicago. The **"Quick Lockcet"** (right illustration) is designed for light, fast work. It is made in three sizes and may be obtained with fibre jaws, if desired, for work on aluminum and other softer metals. Teeth hold a ratchet grip on the screw under spring tension. Trigger pressure by thumb or finger releases this grip instantly; the screw may then be reclamped to other work of the same thickness without further adjustment.

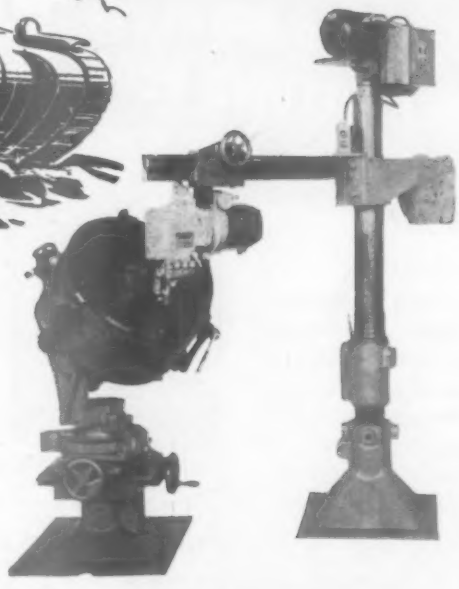
The **"Heavy Duty Speed"** clamp (left illustration) is a two-handed, lever-operated clamp for large heavy work such as the welding of heavy plate, bulky weldments, etc. The combination screw and lever action permits this clamp to be set with the screw and locked for a given opening and then applied or released with the lever. If desired, this clamp may be obtained in "Giant" size with a 10½ in. opening.

The third new line is the **"Alloy-Steel"** line of standard C-clamps. These are made of new heat-treated alloy steels which are said to give both greater strength and lighter weight than the materials formerly used.

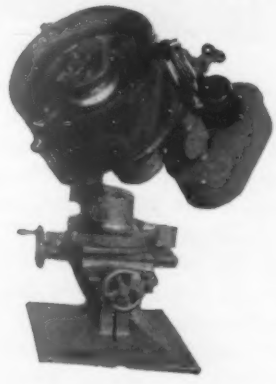
"Lockcet" (right) and "Heavy Duty Speed" are two of three new clamp lines announced by Grand Specialties.



Quicker Welding . . . With This Automatic Welding Machine Fixture



Reloading Is done During Welding Operation



THIS Acme dual fixture arrangement permits practically constant use of an automatic welding head, because one of the fixtures can be reloaded while the other is engaged in the welding operation.

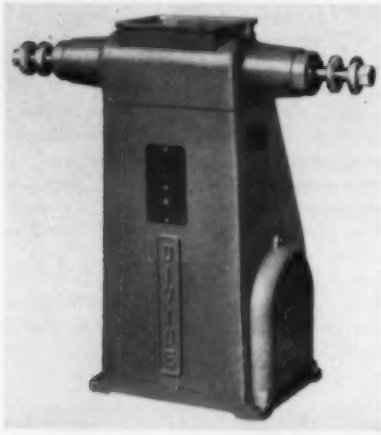
The holding machine can be set to revolve at any angle from vertical to horizontal. (Illustration shows a wheel being welded at 45° angle.) Positioner arm swings from one fixture to the other, locking in proper position. Speed of rotating the work is adjustable, as desired.

ACME Manufacturing Co.
1642 HOWARD ST. • DETROIT, MICH.

WRITE
for information. Whatever your positioning problem on automatic welding, let us help you solve it. Write for complete information.

Light Duty Lathe

★ A V-belt-driven lathe which may be used for grinding small weldments, polishing small parts and burring is offered by **Divine Brothers Co.**, Utica, N. Y., with motor sizes up to 3 hp and a spindle speed range up to a top of 3,850 rpm. The standard spindle is 1¼ in. in diameter, 44 in. long and suitable for use with wheels up to 2 in. Optional extras are a longer spindle, two-speed drive and a magnetic starter.



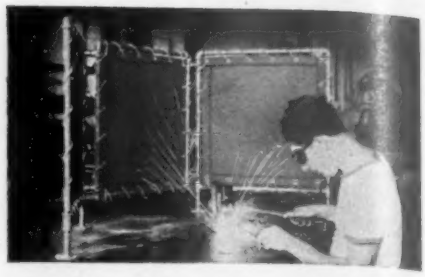
Divine VJ lathe. It may be used for grinding small weldments, polishing, etc.

» «

Welding Screen

★ The **Dandux** welding screen is made of heavy flameproof canvas while frame is of galvanized iron pipe fitted with either casters or screw-plate flanges. These screens, states manufacturer, meet all safety regulations and will permit welding to go on in close proximity to other manufacturing processes—even on the same bench if necessary.

For larger weldments, curtains are offered of the same material as the screens. These are furnished with sliding rings to hold the curtains from a pipe framework. **C. R. Daniels, Inc.**, 44 West St., New York City



Dandux welding screen. It is easily portable, occupies little floor space.

» «

Hydraulic Elevating Table

★ Improvements that further extend the adaptability of the **Lyon hydraulic elevating** table are announced by **Lyon-Raymond Corp.**, 1270 Madison St., Greene, N.Y. The standard stock table (1) can now be furnished with seven different optional features. These are shown in the illustration as follows: a floor lock (2 and 3) to keep the table from moving on its casters; a spring balanced towing handle (7); locking device which allows table top to be turned and locked each 15 deg throughout the entire circumference (4); collapsible retaining bars for table sides (6) to hold work on table; four swivel casters in place of the standard two swivel and two stationary casters; optional stationary type, *i.e.* with feet in place of casters (5). A two-speed hydraulic foot pump has been substituted for the single speed pump; the double speed is advantageous with the lighter loads.

Improved Lyon hydraulic table (see text for key to the numbers). This model elevates a load of up to 2,000 lb a maximum of 14 in.

For big jobs with big responsibilities . . .
BRIDGEPORT BRONZE WELDING RODS
"Equal to any job, worthy of your skill"

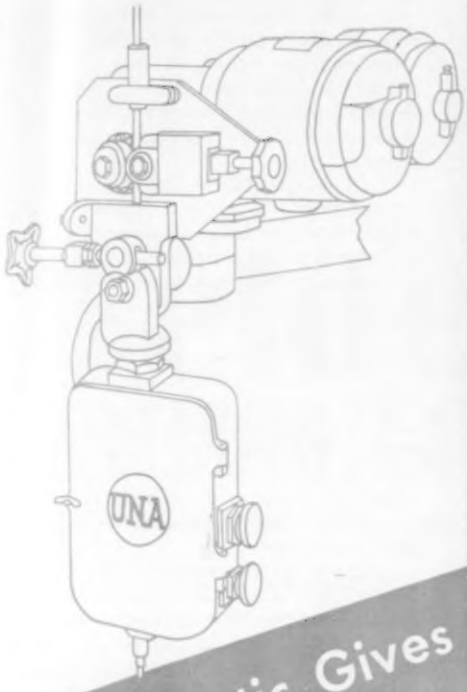
FACTS for WELDERS . . . Practical, up-to-the-minute data. How to select and use bronze welding rods for best results. It is yours free by writing Bridgeport.

Today's welding jobs all have one thing in common, whether they are new work or repair . . . each must be made long-lastingly dependable through strong, dense, tough welds. The most skillful welders, however, realize that results can be only as good as the welding rod they use. That is why specifying "Bridgeport" on welding rod orders is so highly important today. For you can depend on the reliable, uniform, workable qualities . . . the easy flow and good tinning action . . . and the smooth, easy machinability of Bridgeport Bronze Welding Rods.

BRIDGEPORT BRASS

"Bridgeport" BRIDGEPORT BRASS COMPANY • BRIDGEPORT, CONN. • ESTABLISHED 1865

"I never have any trouble with the blueprints," boasted a new helper who had been listening to a group of workmen discussing their relative abilities in reading blueprints. "It's the white lines I can't understand."—*Joseph Schuman*

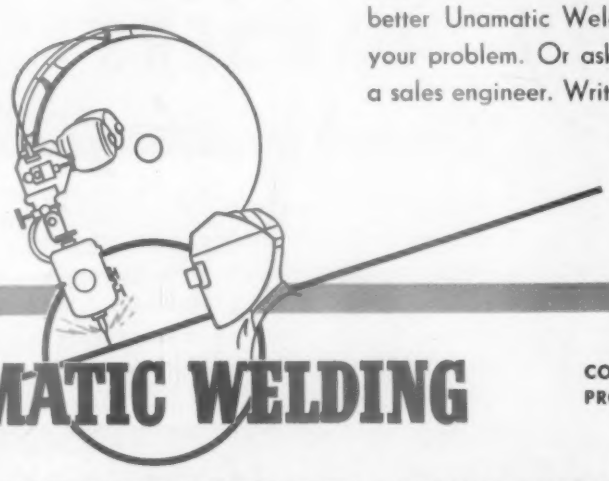


Unamatic Gives You Faster, Better Welding WITH LOWER COSTS

CIRCUMFERENTIAL welds as small as two inches in diameter or straight welds 240 times as long indicate the range of application of Unamatic Welding equipment. Wherever it is applicable Unamatic Welding is faster or better or cheaper than manual operation and usually it is all three.

Unamatic Welding gives you two big advantages—a continuous, uninterrupted pass and closely controlled quality. Once you decide the most practicable set-up and fit-up for the job, Unamatic equipment and materials insure you exact repetitive duplication. Your costs on production work can be figured closely without risk.

Right now Unamatic shielded arc and light coated welding has hundreds of different applications in war production. To find out the quickest way, how you can use faster and better Unamatic Welding, tell us your problem. Or ask us to send a sales engineer. Write now.



CONTROLLED QUALITY

UNAMATIC WELDING

CONTINUOUS PRODUCTION

UNA WELDING INC. • 1615 COLLAMER AVE. • CLEVELAND, OHIO

News of the Industry

AWS Holds 24th Meeting in Chicago, Oct. 18-21

Plans are underway to make the forthcoming annual meeting of the American Welding Society one of the most important and worthwhile gatherings ever held. The meeting is scheduled for Monday October 18 to Thursday October 21, inclusive, at the Hotel Morrison, Chicago. In order not to be disappointed, members of the Society are urged to make their reservations early by writing at once to Leonard Hicks, Jr., Morrison Hotel, Chicago. It is imperative that these letters mention the name "American Welding Society Convention."

Well over 60 papers are to be presented at the technical sessions, three and four of which will be held simultaneously during the morning and afternoon meetings. The technical sessions will cover the following broad subjects: cutting; railroad welding; weldability; resistance welding; flame-hardening and hard-facing; tubing; ships; research; aircraft; non-ferrous welding and brazing; piping; inspection; qualification and training; repair and maintenance; production; pressure vessels. Special emphasis is being laid upon aircraft welding, which is scheduled to occupy three entire sessions on Wednesday morning, Wednesday afternoon and Thurday morning.

Features of the Society's 24th convention will be the Adams lecture by Dr. C. A. Adams, first president and one of the founders of AWS, and an address by Colonel S. B. Ritchie, chief of the service branch of the office of Chief of Ordnance, on welding in ordnance construction.

» «

War to Hold Stage at Metal Congress

Increased war production, conservation of metals and postwar planning will take the center of the limelight at the 25th annual National Metal Congress, to be held in Chicago the week of October 18 at the Palmer House and other Chicago hotels.

"The entire Metal Congress and Conference displays will be tuned to the increase of war production in the metal industry, to the conservation of metals and to postwar planning," said W. H. Eisenman, managing director of the meeting and national secretary of the American Society for Metals, in announcing plans. "All technical sessions and special daily War Production and Conservation sessions will be streamlined and comprehensive in their contributions to the war problems and will contribute decisively and materially to the shortening of the war.

"During the past year, the metal industry has largely finished its plant expansion job for war, and today it is confronted with production problems involving shortages of many strategic metals, more efficient use of equipment and continued training of personnel. All of these problems will be dealt with at sessions of the Congress."

» «

Morgenthau Praises United Electronics

Acknowledgment of the "excellent record" which the United Electronics Co., Newark, is making with its payroll savings plan was received recently from Secretary of the Treasury Henry Morgenthau, Jr. Over 10% of the company's gross payroll is being invested in war bonds. "This is an excellent record," wrote Secretary Morgenthau.

Type CB combines chisel drift and removable brush.

CMD

WELDERS' CHIPPING HAMMERS Speed Up the Job

Thousands of man hours can be saved for war production or maintenance work by equipping your welders with these convenient CMD Chipping Hammers. Well balanced, light and easy to use from any position. First choice of welders since 1925.

Order from your Welding Supply House! If they cannot supply you, order direct! Descriptive circular sent free upon request.

CHICAGO MANUFACTURING AND DISTRIBUTING COMPANY
Dept. W., 1928 West 46th St., Chicago, Illinois

Belden
WELDING CABLE

Rubber Covered ★ ★ Super-Flexible

SIZES AVAILABLE
#4 to #4/0
125 to 550 Amps.

PROMPT SHIPMENTS ! !

LOW PRICES!
(Large or Small Quantities)

Buy { By MAIL / TELEGRAPH / TELEPHONE

CONTINENTAL WELDING CABLE CO.

PHONE FRANKLIN 7100

333 NORTH MICHIGAN AVENUE CHICAGO, ILLINOIS

You Weld Fast!
AT LOWEST COST
● Your welds are stronger and better when you use a Miller AC Welder and your costs are lowest, because: You save time and labor on the job — speeding production. You save on electrode and power costs — on installation and maintenance, too.
Miller AC Welders
Made in ten models for every shop and industrial need.
Prompt delivery now. Write for full information.
MILLER ELECTRIC MANUFACTURING CO.
Sales: Richmond, Indiana • Factory: Appleton, Wisconsin

MILLER AC MEANS STRONGER, BETTER, LOWER-COST WELDS

WPB Order L-298 Affects Spot Welding Equipment

On and after July 27, no manufacturer or dealer may accept an order for or deliver any new resistance welding equipment unless the order or delivery has been specifically authorized by the War Production Board on Form WPB-2752, it is stated in General Limitation Order L-298, issued by WPB on July 12.

According to the new order, the fulfillment of war requirements has created a shortage in the materials used in the manufacture of resistance welding equipment. To enable the compilation of accurate statistics, an operations report on Form WPB-2830 must be filed on or before the 15th day of each month, commencing with August, by each "manufacturer," defined as any person engaged in the business of producing, fabricating or assembling resistance welding equipment. This report is to show orders (for new and rebuilt resistance welding equipment and repair parts) unfilled, received, shipped and cancelled during the preceding month.

Idle equipment is also affected by Order L-298. Paragraph (d), *Registration of idle equipment*, provides as follows:

"(1) Whenever any used resistance welding equipment (other than portable gun welders and resistance welding electrodes) has been idle for a period of 90 consecutive days ending on or after July 12, 1943, without having had its ownership changed, the owner of the equipment shall register it, within 30 days after the 90 day period, by filing Form WPB-2732 with the War Production Board . . . Used resistance welding equipment shall be deemed to be idle for a period of 90 consecutive days unless, during any such period, it has been employed for welding operations for more than 120 hours in the aggregate.

"(2) Within five days after any used resistance welding equipment registered under paragraph (d) (1) has been sold, the seller shall register such change of status by filing with the War Production Board Form WPB-2732."

» «

Veteran Weldor Selected for "Dad's Day" Honor

Tribute to the nation's weldors was paid by the National Father's Day Committee in the selection of a veteran weldor, H. W. Dean, Sr., as the "War Worker Father of 1943." Dean is employed by the Tampa Shipbuilding Co., Tampa, Fla. He is a veteran of World War I, has two sons in this one, and has spent a major part of his past 24 years as a structural iron worker, welding operator and welding school instructor.

The honor of "War Worker Father" carried with it a trip to New York City, Baltimore and Washington, receptions by the mayors of the three cities, radio broadcasting and the acceptance of a medal presented by Admiral Emory S. Land, chairman of the U. S. Maritime Commission.

Electronic Tubes Starred in New Westinghouse Film

Electronics at Work, a new 20-minute educational sound film, has just been released by Westinghouse. This film makes use of animated drawings to explain the six basic functions of electronic tubes—to rectify, to amplify, to generate, to control, to transform light into electric current and to transform current into light.

The animation is varied by actual "at work" scenes showing the application of electronic tubes to resistance welding controls, radio and radio-telephony, high frequency induction heating, industrial and medical X-rays, radar, etc.

This film is available in 16 mm prints and will be loaned free for showing at war plants and engineering and technical societies. Inquiries should be addressed to Dept. 7-N Westinghouse Electric and Mfg. Co., East Pittsburgh, Pa.

» «

Allis-Chalmers Film Shows Steam Turbine Operation

A new 16 mm sound film, "The Magic of Steam," has been produced by the Allis-Chalmers Mfg. Co., Milwaukee, to tell a graphic story of steam turbine theory and principles.

By means of simplified animated drawings, the complicated mechanics of the steam turbine are made clear to war plant trainees, for whom the film was primarily made.

G-R 49

POWER FACTOR CORRECTED

has the STAYING POWER!

...Built for War Production

3-shift 7-day schedules are made to order for G-R 49. Here's a husky welder with plenty of "staying power", readily adapted from hand to automatic operation, and *extremely* cool when the going is tough.

Two open circuit voltages greatly widen its field of welding applications. G-R 49 is supplied with contactor having push-button control for power supply, handles rod from 1/8-inch to 5/8-inch with only a twist of the hand wheel. Welding range 100-675 amperes. Get the whole story from your nearest G-R Distributor.

GLENN-ROBERTS COMPANY

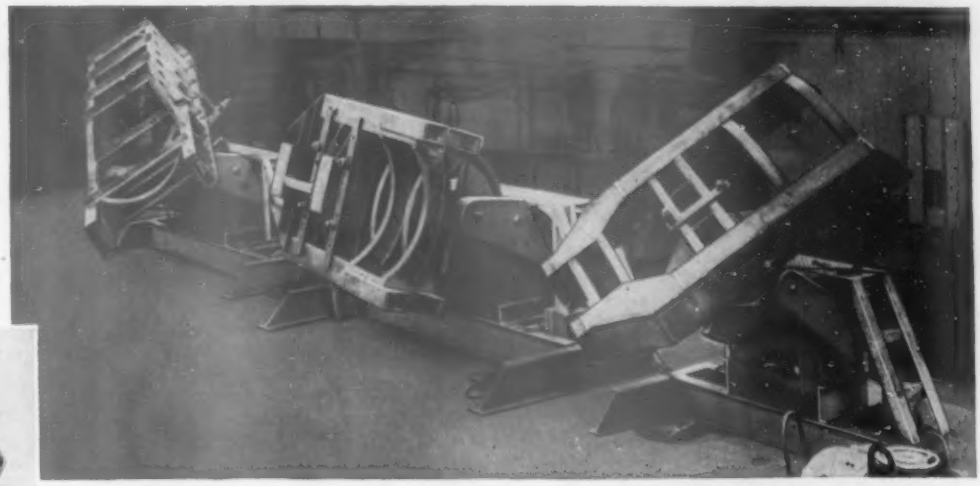
1009 FRUITVALE AVENUE, OAKLAND, CALIFORNIA

2107 ADAMS STREET, INDIANAPOLIS, INDIANA

P. O. Box 1814, Washington, D. C.

POSITIONING PERMITS YOUR WELDERS TO CONCENTRATE ON WELDING...

In handling these cumbersome frame assemblies, the welders can swing them through 360° and tilt them as far as 135° beyond horizontal. Both men and women welders like Ransome equipment because it steps up their production and reduces fatigue.



6,000-lb. capacity unit.

It's certainly not good business to waste welders' time and energy in "rasseling" the work around . . . not when a Ransome Positioner will do the job at the touch of a switch.

This equipment improves quality by providing the correct downhand position for every weld, saves valuable floor space, promotes safety, and speeds up welding production generally.

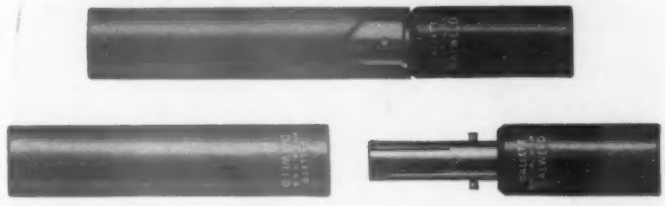
There's a type and size for *your* welding needs . . . in a line that extends from light-duty hand-operated up to 40,000-lb. capacity.

» Write for full information.

Ransome WELDING POSITIONERS

INDUSTRIAL DIVISION • RANSOME MACHINERY COMPANY • DUNELLEN, NEW JERSEY

"DALWELD" DETACHABLE WELDING CABLE CONNECTOR *features:*



- Constructed for rough usage
- Large area contact
- Fully insulated
- Quick acting
- Quarter-twist connects or disconnects
- Cannot accidentally be pulled apart

The "Dalweld" saves time, power and cable; standard in many small shops, and the country's largest shipyards, aircraft factories, tank shops, etc. Write for descriptive literature.

THE DALLETT COMPANY

MASCHER AT LIPPINCOTT STREET — PHILADELPHIA 33, PENNSYLVANIA

PNEUMATIC "WELD-FLUX" SCALING HAMMERS ■ "DALBO" AIR HOSE COUPLINGS

"DALLETT" PNEUMATIC SAFETY RETAINER SHANK CHISELS

■ ■ *PNEUMATIC AND HAND CHISELS* ■ ■

25th Birthday of Omaha Welding Co.

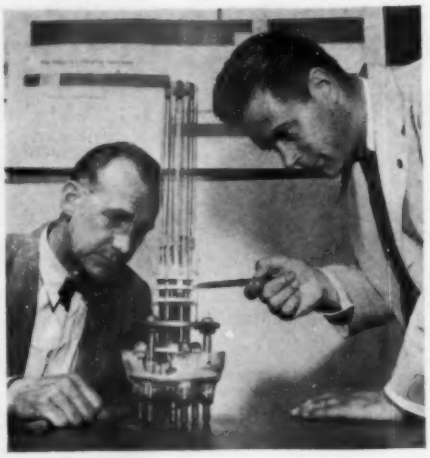
Back in the early days of welding—on July 18, 1918, to be exact—L. O. ("Heinie") Schneiderwind started The Omaha Welding Co. in a little one-room rented shop. Last month this concern celebrated its 25th birthday. During the quarter of a century, the plant has grown from 252 to 16,000 sq ft, the organization from one to 34 men, the sales force from none to four men who cover 7 states and represent 34 national manufacturers for whom the firm serves as distributor.

In addition to commercial welding jobs and distributing, the Omaha Welding Co. has its own manufacturing division—the Will-Weld Mfg. Co., building an A-C arc welder. It also operates its own welding school—the Omaha Welding School—which was established by Heinie Schneiderwind even before the present war program had thrust unprecedented importance upon the welding trade.

» «

Industrial Electronic Applications Centralized

To promote the use of electronics in industry on a broad engineering and commercial basis, Westinghouse Electric and Mfg. Co. has established a new central group of electronic engineers who will guide and direct the industrial, utility and transportation electronic applications.



SENIOR ENGINEERS Gordon F. Jones (left) and Carl J. Madsen, who will coordinate electronic activities for Westinghouse, are shown examining the elements in a partially dismantled 100 kw oscillator tube similar to those used for high frequency induction heating and radio.

Two senior engineers, Gordon F. Jones and Carl J. Madsen, will head the new Industry Engineering group, while Amos J. Germain will be in charge of commercial relations. Mr. Jones will specialize and act as consultant on conversion problems, including power rectification and inversion, in the utility, industrial and transportation fields. Mr. Madsen will act as a consultant in connection with electronic methods in process and speed control, induction and dielectric heating.

This step in centralization is being taken to accomplish three primary objectives: first, to expedite present wartime applications; second, to prepare for postwar applications of the present war developments, and, third, to make the developments and improvements which have been found practicable in one industry immediately available to all industries.

» «

Contest Uncovers Poet War Worker

In a poster title contest recently conducted among the 12,000 workers of General Cable Corp., William S. Porter, of the company's Perth Amboy, N. J., plant, won first prize, a $100 war bond, with a dramatic poem. The two stanzas being used on the poster are:

Dare you to say or think you do not feel
The bullet that has pierced the flesh of him
Who fought so gallantly, with fiery zeal,
While thinking not of loss of life or limb?

Dare you deny to those who enter hell,
For war is hell for all our fighting crew,
The hours of sticking on your job? Think well,
For if you dare, then we are lost . . . and YOU!

This effective message will appear on a painting by C. C. Beall, who is currently doing a series of covers for *Colliers.*

C-F POSITIONERS *Cut Welding Time Reduce Welding Cost Improve Welding Quality*

All sides, top and bottom, are welded downhand with one set-up. No waiting for the crane, no "handling" crew needed, for the welder himself rotates (360°) and tilts weldment (to 135° beyond horizontal) with a push button control. This "all-down," hand welding method permits use of larger rods, hence requires fewer passes and gives stronger, smoother, more uniformly flawless seams and joints.

C-F Positioners, pedestal mounted and adjustable for height, come in 6 capacities —from 1200 lbs. to 30,000 lbs. Manual, motorized or motorized variable speed operation.

Write for Bulletin WP-22

CULLEN-FRIESTEDT CO.

1309 S. Kilbourn Ave., Chicago, U.S.A.

Full Speed Grinding under Full Load

1843 STANLEY 1943

STANLEY No. 566 Portable Grinder

This heavy-duty tool is just right for preparation work before welding, and cleaning up afterward. It's well balanced for easy handling without "bucking". Built to stand up. Use it with a torque brush for cleaning rust, etc.

Write for specification sheets. Stanley Electric Tool Division, The Stanley Works, 177 Elm Street, New Britain, Connecticut.

STANLEY ELECTRIC TOOLS

A Complete Line for Industry

(Trade Mark Registered)

Doubly-Deoxidized Welding Alloys:

PENN BRONZE

TITAN BRONZE

TITAN MANGANESE BRONZE

Specify Titan Welding Alloys

TO ASSURE UNIFORMLY SOUND, STRONG, DUCTILE BRONZE WELDS

Doubly-Deoxidized PENN BRONZE, TITAN BRONZE and TITAN MANGANESE BRONZE Welding Rods have proved their definitely superior welding qualities over a period of many years and under the most exacting requirements.

The Double-Deoxidization process, developed by Titan engineers, definitely increases the ductility of the weld metal, reduces fuming to a minimum and assures a sound, dense, strong weld.

Descriptive literature sent upon request

TITAN METAL MANUFACTURING CO., BELLEFONTE, PA.

TITAN WELDING RODS

Engineers View Electrode Plant

Several hundred selected guests including welding engineers, members of foreign purchasing commissions and representatives of welding electrode manufacturers were shown an unusual exhibit during the week of June 27 by the Moslo Machinery Co., Cleveland. That exhibit was a complete electrode processing plant in actual production.

As nearly as possible, the exhibit was a typical layout of actual production installations, and the guests were shown step-by-step operations in the forming and cutting of welding electrodes. Complete runs were made every day, starting with the mixing of fluxes and the straightening of wire and steel coils and concluding with completed electrodes.

ABOUT PEOPLE

Fred T. Whiting and **Charles A. Dostal** have been elected vice-presidents of the Westinghouse Electric and Mfg. Co. Mr. Whiting is manager of the company's northwestern district, Chicago, and Mr. Dostal is manager of the Pacific coast district, San Francisco.

» «

Joseph L. Mullin has been appointed general superintendent of foundries for the American Manganese Steel Div. of The American Brake Shoe Co., Chicago Heights, Ill. **W. F. Kelly,** formerly plant superintendent at the company's New Castle, Del., plant, has been named works manager at that place to succeed Mr. Mullin.

» «

Robert L. Coe, vice-president of the Chase Brass & Copper Co., Inc., was re-elected president of the Copper & Brass Research Association at its recent 22nd annual meeting. Vice-presidents elected were: **Wylie Brown,** president Phelps Dodge Copper Products Corp.; **William M. Goss,** vice-president, Scovill Mfg. Co.; **Curtis L. Smith,** treasurer, The National Copper & Smelting Co; **Herman W. Steinkraus,** president, Bridgeport Brass Co. **C. Donald Dallas,** president of Revere Copper and Brass, Inc., was re-elected treasurer. Other officers re-elected were **Theodore E. Veltfort,** manager, and **Bertram B. Caddle,** secretary.

» «

H. B. Hodgins, an application engineer for Westinghouse Electric and Mfg. Co. in the Spokane, Wash., area since 1935, has been named manager of the company's Spokane office.

» «

Dean Harvey, materials engineer of the Westinghouse Electric and Mfg. Co., was elected president of the American Society for Testing Materials at its recent annual meeting in Pittsburgh. **John R. Townsend,** material standards engineer for the Bell Telephone Laboratories, Inc., New York City, was elected vice-president.

» «

John E. Mateer, formerly assistant superintendent, has been appointed superintendent of the open hearth department of Lukens Steel Co., Coatesville, Pa. He succeeds **Herman J. Hofmann,** who resigned because of ill health.

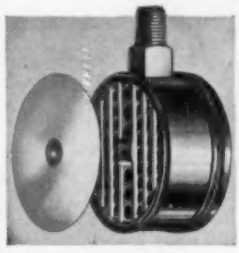
Robert G. Bloom has been appointed controller of Lukens Steel Co.

» «

Wallace W. Leipner has been appointed acting chief engineer of the American Welding and Mfg. Co., Warren, O. He was formerly assistant to the vice-president in charge of engineering. **Verne Wildman,** formerly general foreman of the machining department, has been promoted to assistant superintendent of the company.

» «

Walter E. Ellsworth has been elected chairman of the Indianapolis Chapter of the American Society for Metals. Mr. Ellsworth is Indianapolis manager of Claud S. Gordon Co., Chicago.



EXCLUSIVE SAFETY FEATURE

The grid-plate shown above is exclusive with Moto Meter Pressure Gauges—an extra safety feature.

MOTO METER **PRESSURE GAUGES** FOR OXY-ACETYLENE APPARATUS

Like magic, the bright flame of the welder's gas torch speeds to accomplishment the tasks of construction, conversion, reconditioning, repair. Serving to maintain oxy-acetylene welding at peak efficiency are Moto Meter Pressure Gauges. Ever-present aids to the welder, they help to insure correct pressures for each job and to conserve vitally needed gas for additional operations.

THE ELECTRIC AUTO-LITE COMPANY

MOTO METER GAUGE & EQUIPMENT DIVISION

CHRYSLER BUILDING, NEW YORK, N. Y.

FACTORY LA CROSSE, WISCONSIN

HERCO VARIABLE CORE ARC WELDERS *for:*

MODELS FROM 150 TO 1500 AMPERES WITH OR WITHOUT POWER FACTOR CORRECTION

24 hour per day operation.
Exact heat control.
Increased production.
Lower power costs.
X-ray test welding.
Ease of operation.

Inquire about
MAGNETIC CLAMPS
for quick positioning
and alignment.

HERCULES ELECTRIC & MFG. CO. INC.

MANUFACTURERS OF THE PRECISION WELDER WITH THE

STREAMLINED ARC

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You're Never Caught Short
● With a Sight Feed Generator you never lose your heat in the middle of a job. You always have plenty of acetylene—never have to wait on delivery from a "bottler." And you cut acetylene costs up to 75%.
You see the "charge" in a Sight Feed and your acetylene supply is assured.
You operate any torch at any desired pressure with a Sight Feed Generator.
Sight Feed
GENERATORS
Made in a range of sizes—in portable and stationary models—for all shop and industrial service needs. Sight Feeds are listed for safety by UL and FM. Write for full information.
THE SIGHT FEED GENERATOR COMPANY
Sales: Richmond, Ind. Factory: W. Alexandria, O.

Helpful Literature Just Published

The following reviews are of recent publications of interest to those in the welding industry. Unless otherwise stated, they may be obtained without cost by writing to the manufacturers listed.

G-E. Catalog

A large and complete line of arc welding accessories is presented in the new 36-page, 8 by 10½ in. catalog (GEA-2704C) issued by the G-E Welding Div. Inside a cover featuring Joe and Josephine Magee is a comprehensive description of the full G-E line of chrome-leather, asbestos, and flameproofed-duck protective clothing, ranging from glove and sleevelets to complete ensembles, for both men and women weldors. Among the other items illustrated and described are ventilated helmets and head protectors, observation shields, electrode holders and various kinds of miscellaneous welding equipment such as slag chippers, electrode carriers, and fillet-weld gauges. Also listed are standard sets of welding accessories and renewal parts for them. **General Electric Co.**, Schenectady, N. Y.

» «

Welding and Cutting Charts

Two charts in a handy pocket-size have been issued by the **Victor Equipment Co.**, 844 Folsom St., San Francisco, as aids to weldors and cutters in stepping up wartime industrial production. These charts present ready-reference tabulations of such data as torch tip and drill sizes, oxygen pressures, consumption, gas pressures, cfm of acetylene, cutting speeds, flame cone lengths, metal thicknesses and other information needed when welding and flame-cutting.

» «

"Electronics at Work"

Electronic applications in industry, in the war, in medicine and in the home are illustrated and described in a handsomely printed 44-page, 10¾ by 8¼ in. booklet published by Westinghouse. Copious photographic reproductions picture such applications as: resistance welding control for "sewing" plane parts together at 1,800 spots per minute; high frequency induction heating units for tin flowing, surface hardening, and plastic molding; ignitron rectifiers in aluminum and magnesium production; industrial X-ray units for inspection of metal parts; "Precipitron" removing of air-borne dust particles, etc. Various types of electronic tubes for these and other uses are illustrated and identified. A copy of "Electronics at Work" (booklet B-3264) may be secured from **Dept. 7-N-20, Westinghouse Electric and Mfg. Co.**, East Pittsburgh, Pa.

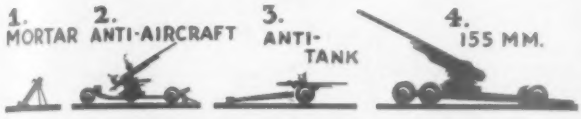
» «

Low Temperature Welding Chart

Comprehensive data on welding with low temperature alloys are compiled on one large chart, 23 by 11 in., copyrighted by **Eutectic Welding Alloys Co.**, 40 Worth St., New York City. This chart lists the proper Castolin alloys to be used for cast iron, for steels, for copper, brass and bronzes, for building up worn machine parts, for nickel and nickel alloys, for aluminum and aluminum alloys, for die castings and for hard-facing. Opposite each alloy is given its binding temperature, tensile strength, Brinell hardness, color match, corrosion resistance, electrical conductivity, composition, heating methods which can be used, edge preparation, recommended fluxing method, and preheating requirements.

Send US YOUR
OLD WELDING
and CUTTING TIPS
for Reconditioning
Don't throw away your old worn out welding and cutting tips—send them to us and we will recondition them. We can salvage up to 70% of all tips sent to us. Here is a chance for you to help conserve on critical material by re-using the tips you thought were beyond repair. Send your order in today, it will receive prompt attention.
DOCKSON CORPORATION
DOCKSON 383 WABASH AVENUE DETROIT, MICH.

It takes ALL FOUR to win VICTORY . . .



On the FIRING LINE . . .

Sure, they all shoot shells. And they're all equally important. But each one does certain jobs better than the others can do it. That's why Uncle Sam's fighters use ALL FOUR!

And on the PRODUCTION LINE . . .

BENTLEY

Welding Positioners

ARE EQUALLY IMPORTANT

MM-5

Hand Tilt
Hand Rotation

Indexing rectangular parts at constant angle of tilt.

MV-5

Hand Tilt
Variable Speed
Rotation

Rotating circular parts at desired welding speed for hand or automatic welding at constant angle of tilt

AM-5

Air-Actuated
Hydraulic Tilt
Hand Rotation

Indexing rectangular parts and tilting from horizontal to vertical by shop compressed air

AV-5

Air-Actuated Hydraulic Tilt Variable Speed Rotation with power tilt through 90 degrees—the all-purpose machine

ALL FOUR of these Bentley Welding Positioners hold, tilt and rotate a weldment. One of them is operated by hand. One has hand tilt with variable speed power rotation. One has air-actuated hydraulic tilt and hand rotation. And one has air-actuated hydraulic tilt and variable speed power rotation. Possibly you could do all your positioning with any one type (500 lb. capacity, 6 in. above and off center of faceplate). But you could do a better job by selecting one or more of the various types adapted for certain specific jobs. FOR EACH OF THE FOUR DOES CERTAIN JOBS BETTER. And a combination of ALL FOUR will give your shop that EXTRA PUNCH which spells victory on every contract and in the face of any competition.

Write or wire for full description and prices. Prompt delivery.

BENTLEY WELDERY, Inc.

Syracuse, N. Y.

Be sure of FREEDOM from INJURIOUS FUMES

by using FLUXINE No. 18 and No. 43

Your operators will have no irritation of eyes or nostrils when using Fluxine No. 18 and No. 43.

In planning these fluxes, the good health of users was the first and most important goal.

Moreover, Fluxine No. 18 has "won its wings" . . . has been used since soon after Pearl Harbor by leading fabricators for gas welding stainless steel manifolds, muffler tubes and exhaust pipes for Uncle Sam's combat air craft. It produces perfect bonds with greatest economy.

Meets Air Corps.Spec.No.11314; Navy Spec. No. 51-F-3A. Paste from No. 18 does not harden.

FLUXINE No. 43 is ideal for Silver soldering stainless steel, with low melting point silver solders. Most economical for brazing shells with silver solder rings. Meets Navy Spec. No. 51-F-4A; Air Corps Spec. No.11316-A; Federal Ordnance Dept. Spec. No. AXS-500. Krembs makes:

89 DIFFERENT FLUXES . . . each for specific jobs. Explain your metal joining problem fully and a sample with instructions will be sent free.

KREMBS AND COMPANY

671 West Ohio Street, Chicago 10, Illinois

Chemists and Metallurgists Since 1875

FLUXINE

TRADE MARK REGISTERED U.S. PAT. OFF.

FLUXES TO JOIN ALL METALS

Resistance Welding Data

"Recommended Practices for the Spot and Seam Welding of Low Carbon Steel" is a 4-page, 6 by 9 in. AWS publication intended to meet the needs of the Navy and War Departments and those engaged in the production of war materials. The data have been compiled by canvassing approximately 60 fabricators of mild steel structures and resistance welding equipment manufacturers and are said to represent the best information available at this time on the important subject. The material is presented in the form of two charts—one for spot and one for seam welding. **American Welding Society,** 33 West 39th St., New York City; price 10 cents.

» «

Salt Bath Booklet

The Brown Instrument Co., Wayne and Roberts Avenues, Philadelphia 44, has issued a new 18-page, letterhead-size bulletin, No. HT-S-2, describing a recommended pyrometer control system for high-speed salt baths. These baths are used because of their inherent ability to exclude atmospheric air from the work during heat treatment and are used principally for the hardening of high carbon steels. They may also be employed for copper brazing and silver soldering operations. The bulletin describes the use of equipment providing the close temperature control needed for steel hardening.

» «

Weldor's Check Charts

Three essentials of proper welding procedure—correct electrode, correct travel speed and correct welding current—are graphically illustrated in two 18 by 33 in. wall charts offered by **The Hobart Brothers Co.,** Troy, O. These welding check charts will be sent to any interested person who writes for them and encloses 10 cents in stamps to cover the mailing cost.

How to get good welds and what electrodes to use are graphically portrayed in these 18 by 33 in. wall charts just published by Hobart.

One chart pictures the characteristics of weld deposits made under the following conditions: welding current too low, welding current too high, arc too long (voltage too high), welding speed too fast, welding speed too slow, proper current plus correct speed. Other information includes the speeds in feet per hr that can be obtained using specific electrode sizes, how to cut electrode waste and care of welding equipment.

The second chart lists 19 classifications of electrodes and describes the use and purpose of each grade for particular welding jobs. An "Alloy Metals Finding List" and list of sources is printed on the backs of both charts.

» «

Tempilstik Folder

Functions of Tempilstik, Tempil pellets and Tempilaq liquid are described in a 3½ by 8¼ in. folder, "A New Way to Measure Industrial Working Temperatures." These products have a sharp and rapid melting action at stated temperatures, enabling them to be used as a convenient means of signaling when critical temperatures have been reached in various industrial operations, including welding. **The Tempil Corp.,** 132 West 22nd St., New York City.

YOU'RE ENTITLED TO MORE THAN DESCRIPTION WHEN BUYING PROTECTIVE LEATHER CLOTHING

WELDERS' protective garments and accessories should be made of leather and most of them are. Careful buyers of this equipment concern themselves with leather quality and no longer accept the designation "chrome tanned" as an index to good performance.

CHROME TANNED means a generally used process of leather making—a method wherein chromium salts are employed instead of other tannic agents. The chrome process is used by most tanners, including ourselves. But no quality is signified by the term.

QUALITY LEATHER is the result of good selections of hides, experienced craftsmanship and business standards. The right raw material expertly converted makes the supple, tough wearing leather so essential for welders' protection and comfortable use.

REMEMBER, CHROME IS A DESCRIPTION OF PROCESS— LICHTMAN IS AN IDENTIFICATION OF MERIT.

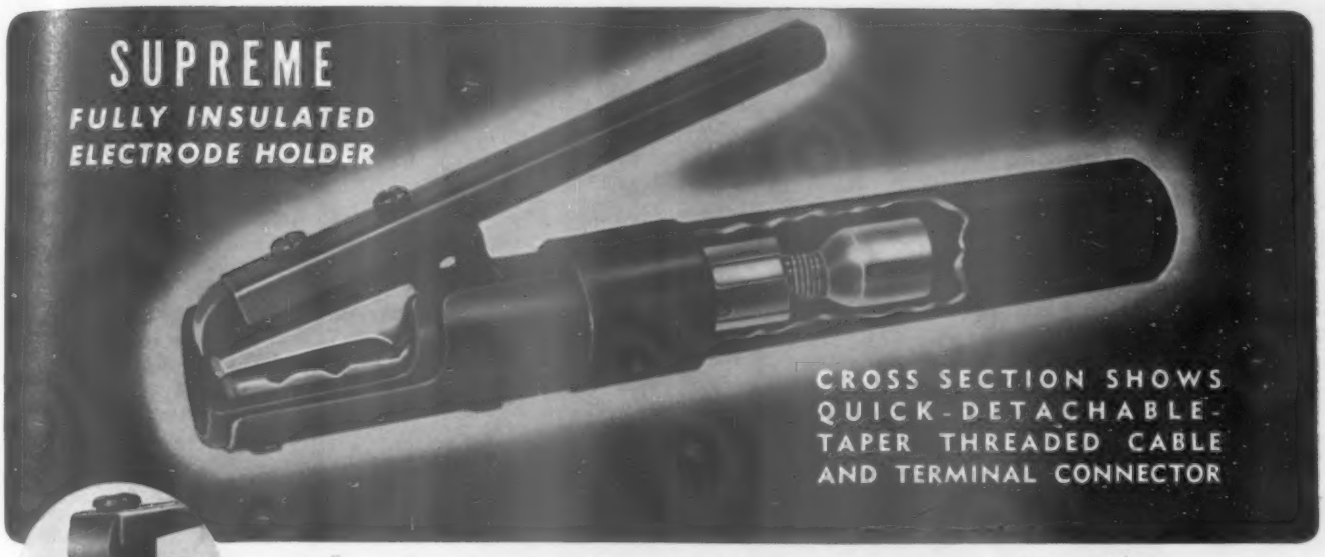
LICHTMAN J.L.&S. LEATHERS
TRADE MARK

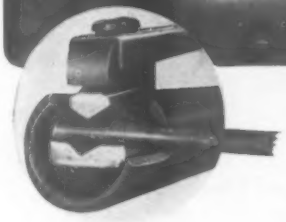
LEADING MANUFACTURERS of welders' clothing use LICHTMAN leather. Under existing conditions, it is not always possible for us to supply their full requirements. The reasons are obvious. When you can get equipment of our tannage rest assured you're getting "tops"!

J. LICHTMAN & SONS

Tanners of Quality Leathers Since 1883

NEWARK, NEW JERSEY



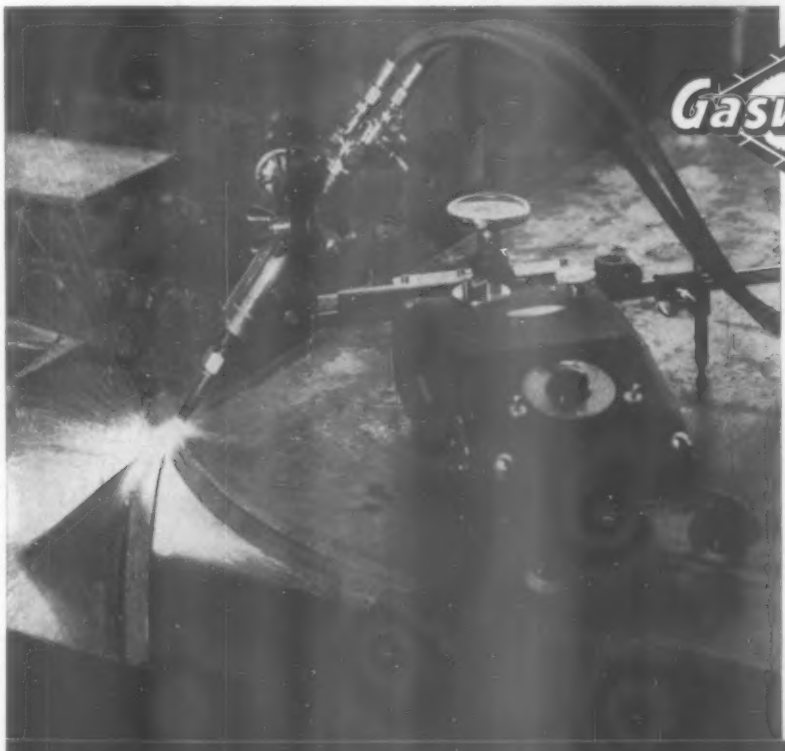


★ WITH "ROD ECONOMIZER" JAWS . . .

Air cooled completely — lightweight (1 Lb.) — balanced advantageously. Deoxidized copper throughout — high tension rod clamping with easy release pressure. Parts easily replaced.

Circular on Request . . . Attractive Prices . . . Order Sample Holder Now

WELDING ENGINEERING COMPANY
MILWAUKEE, WISCONSIN
MANUFACTURERS — DISTRIBUTORS
OFFICES AND AGENTS ALL OVER THE UNITED STATES



Gasweld

G-W PORTABLE FLAME CUTTING MACHINE

• The "Gasweld" G-W Flame Cutting Machine is a portable, motor driven torch for cutting billets and straight lines, strips, circles, arcs or simple irregular outlines in steel plates. Either straight or beveled edge cuts are easily made.

Cuts can be made clean and accurate, eliminating in many cases, the need for further machining. Light, compact—weighing only 45 pounds—the machine is easily moved from place to place in the shop. Speed range—four to sixty inches per minute; travels either forward or in reverse direction.

The G-W Portable Flame Cutting Machine effectively lowers cutting costs and speeds production over hand-cutting methods.

Write for illustrated bulletin and price to

Buffalo, N. Y.
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WALL CHEMICALS DIVISION of
The Liquid Carbonic Corporation
3110 S. Kedzie Ave., Chicago, Ill.

Rochester, N. Y.
Toledo, Ohio
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Montreal, Quebec
Toronto, Ontario
Windsor, Ontario

Heat Exchanger Tubing Manual

The manufacture of welded steel tubing for heat exchanger and condenser use has expanded materially because of the demand for heat transfer apparatus in the construction of equipment for the production of synthetic rubber and of aviation gasoline. To furnish complete information on this important product, the "Manual of Welded Steel Tubing for Heat Exchanger and Condenser Use," has been issued by the **Formed Steel Tube Institute,** 1621 Euclid Ave., Cleveland. This 24-page, letterhead-size booklet discusses the tube manufacturing process, suggests the information which should be given when ordering, lists standard sizes commonly used for heat transfer applications, and includes fabricating data and tables of tube properties for use in calculating surface areas, carrying capacities, displacements, etc.

» «

"Design for Arc Welding"

Hobart Brothers has engaged Robert E. Kinkead, well known welding consultant, to prepare a series of design suggestions based on his experience in many different industries. Practically every field where welding is possible and advantageous will be covered, it is stated. Though offered without cost or obligation, these design data sheets will be sent only to a selected list of firms and individual executives. For further information, address **The Hobart Brothers Co.,** Box DM-636, Troy, O.

» «

Footwear Standards

Safety standards for women's footwear have been published as "American War Standard Specifications for Protective Occupational Footwear—Z41.2, 7, 8 and 9." These standards cover all of the specifications that have been developed by the ASA War Committee on women's shoes. The four specifications included are: "Women's Safety-Toe (Oxford) Shoes," "Women's Safety Toe (High) Shoes," "Women's Explosives-Operations (Non-Sparking) Shoes," and "Women's Conductive Shoes." A copy of the 24-page, 7¾ by 10 in. booklet may be obtained for 40 cents from the **American Standards Association,** 29 West Thirty-ninth St., New York City.

» «

"The ABC of Electronics"

The fundamental principles of the six basic ways in which electronic tubes function are explained in a new 36-page, 5 by 7 in. book from Westinghouse. Schematic drawings and circuit diagrams are used to explain how electronic tubes rectify, amplify, generate, control, transform light into current and current into light. High frequency heating, dynetric balancing, resistance welding control, radio, television, the "Precipitron," industrial and medical X-rays are a few of the electronic applications discussed. A copy of booklet B-3260, "The ABC of Electronics at Work," may be secured from Dept. 7-N-20, **Westinghouse Electric and Mfg. Co.,** East Pittsburgh, Pa.

» «

Positioner Folder

A two-color folder on positioned welding, Bulletin No. 194, has been issued by the Industrial Division of **Ransome Machinery Co.,** Dunellen, N. J. Field pictures show the use of positioners with a complicated piece requiring many welds, with pipe sections, in welding the seam on a 72 in. circular head and other applications. Positioners representative of the company's line, which ranges in capacity from 500 lb to 20 tons, are illustrated.

» «

Morale Studies

A new series of studies on the subject of employee morale has been made by the Metropolitan Life Insurance Co. This series treats the subject from three different angles, as implied in the titles of the studies: "Planning and Organizing a Morale Program," "Stimulating and Maintaining Employee Morale," and "Reducing Absenteeism through Employee Education." Copies of any or all of these reports will be sent to executives who make their requests on business stationery. Policyholders Service Bureau, **Metropolitan Life Insurance Co.,** 1 Madison Ave., New York City (10).

HOW TO MAKE YOUR GOVERNORS LAST!

Like others manufacturing for war needs, Pierce production is for war and essential industry. For this reason new governors can be supplied only on a priority basis. But Pierce calls attention to these easy measures which will make your present Pierce Governors last and give the best service.

- **CLEAN GOVERNORS** once a month with kerosene, gasoline, or prepared cleaner.
- **INSPECT AND CHECK GOVERNORS** each week when in continuous operation.
- **CHECK OIL LEVEL** every day in manually lubricated governors. SAE 20 is recommended at this time of year.
- **LINE UP** driving pulleys or gears accurately when reassembling governor after cleaning.

Should your governor need repair or reconditioning send it to the factory with the necessary preference rating certificate.

On a Vital Unit of the Portable Welder!

● Pierce Flyball Governor's time-proven flyball design provides simple, mechanical operation that is positive and unfailing . . . giving close, sensitive regulation necessary for perfect welds.

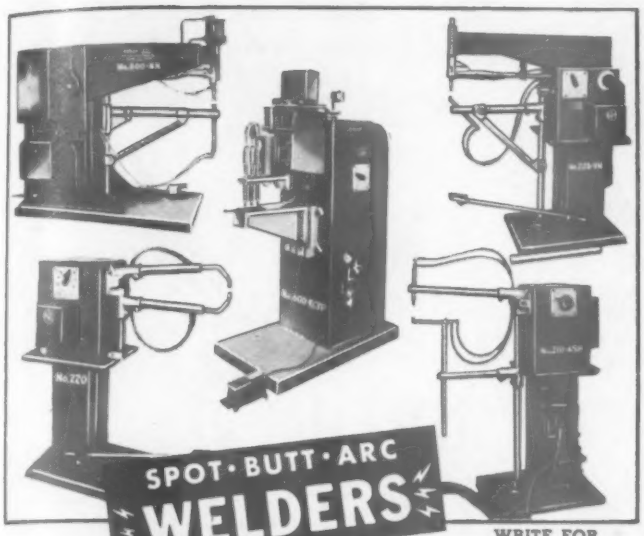
Their action is positive . . . mechanically efficient . . . assuring *complete* recovery of current characteristics within 3/10 second after striking arc.

To be sure of the weld . . . be sure the governor is Pierce. Built by the world's largest governor manufacturers, Pierce Flyball Governors will give you the maximum of service life and satisfaction.

THE PIERCE GOVERNOR COMPANY
1607 OHIO AVENUE, ANDERSON, INDIANA

NOW . . . and after the war . . . specify Pierce Flyball Governors on all of your welding equipment!

Pierce Governors
STANDARD SINCE 1913



WRITE FOR CATALOG

We manufacture a complete line of resistance spot welders from ¼ to 300 KVA for all types of welding. There is an EISLER WELDER for every purpose.

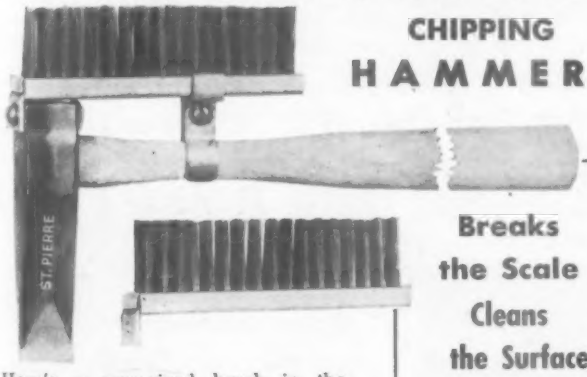
TRANSFORMERS OF ALL TYPES

WE INVITE CONTRACT SPOT WELDING IN LARGE OR SMALL QUANTITIES.

CHAS. EISLER
EISLER ENGINEERING CO.
749-SO. 13th ST. Near AVON AVE NEWARK, 3 N. J.

ABUSE MEANS NOTHING TO ST. PIERRE

CHIPPING HAMMERS



Here's a man-sized brush in the right position for easy use after chipping scale from welded surface. Hammer-Chisel made of highest quality tool steel. Entire tool is well-balanced. For economy, for durability use ST. PIERRE Hammers.

Breaks the Scale Cleans the Surface in One Operation

Order Today From Your Jobber or Direct

ST. PIERRE Chain Corporation
WORCESTER MASSACHUSETTS

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for SUPERIOR HARDNESS and STRENGTH in Bronze Weld Metal, Use Wear-Resisting

AMPCO-TRODE

THE *Original* COATED ALUMINUM BRONZE WELDING ROD

Select From 7 Grades of Coated Aluminum Bronze Electrodes to Obtain the Weld Metal You Need.

With Brinnell hardness from 100 to 350 and tensile strength up to 90,000 psi., Ampco-Trode coated bronze electrodes provide a wide range of physical properties. Thus you can select a grade that matches the base metal or that will be satisfactory for the special service required of the weld metal.

Ampco-Trode coated aluminum bronze welding rods are made from Ampco Metal, well-known in aircraft and industry for its high physical properties, excellent bearing characteristics, and inherent wear-resistance. This alloy is used extensively in War production plants and Ampco-Trode electrodes also are favored by many Government contractors. It is used for building up worn shafts, wear strips and valve seats; overlaying bearing surfaces; and refacing steel and cast iron for added wear-resistance.

Ampco-Trode coated bronze electrodes are suitable for a great variety of applications. Outstanding results will justify your choice. Try them in your plant. Ask for Ampco-Trode Bulletin.

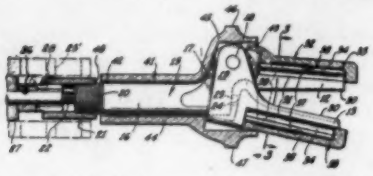
AMPCO METAL, INC.
Department WR-8
Milwaukee 4, Wisconsin

FROM THE PATENT OFFICE

Electrode Holder

2,322,077. **Martin Wells,** Los Angeles, Calif. Filed June 13, 1942. Issued June 15, 1943.

An electrode holder having jaws projecting from the forward portion, means to move at least one jaw toward the other, an insulated handle, tubular insulation on the body, and an insulating means for the jaws. Jaw insulating



means is slidable onto the jaws, and the jaws have retaining grooves which coöperate with their counterparts on the jaw insulating means to effect an interlocking engagement.

Here's how
SKILSAW TOOLS
BOOST PRODUCTION at
LINDBERG ENGINEERING CO.
EVERY MAN
COUNTS FOR MORE
USING SKILSAW TOOLS!
SKILSAW PORTABLE GRINDERS—Speed up all grinding, wire brushing, buffing and polishing on metal surfaces ... remove rust, scale, paint, etc.

SKILSAW PORTABLE GRINDERS—Speed up all grinding, wire brushing, buffing and polishing on metal surfaces . . . remove scale, rust, paint, etc.

SKILSAW DISC SANDERS—Do all sanding, weld grinding and finishing faster and easier on flat or curved surfaces of all materials.

ARMY-NAVY

• Ask over at Lindberg Engineering Company . . . and you'll hear plenty about the speed of SKILSAW TOOLS. Look around the Lindberg plants . . . and you'll see plenty of SKILSAW GRINDERS and DISC SANDERS in action . . . turning out essential heat treating equipment *faster!*

Here's the reason! SKILSAW TOOLS are *preferred* by workers and management alike because they *handle easier* . . . do more jobs *better* and stand up *longer* under today's toughest conditions. Ask your distributor to prove it with a demonstration on your own work *today!*

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New York • Boston • Buffalo • Philadelphia • Cleveland • Detroit
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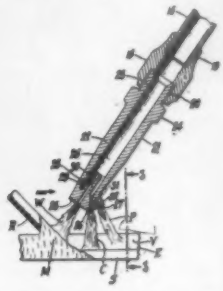
Dallas • Los Angeles • Oakland • Portland • Seattle • Toronto, Canada

SKILSAW PORTABLE ELECTRIC TOOLS
* MAKE AMERICA'S HANDS MORE PRODUCTIVE *

Multi-Flame Welding Tip

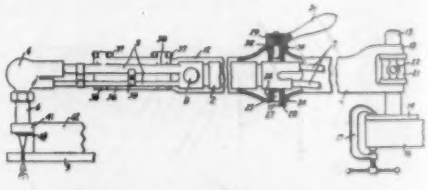
2,322,300. **Walter R. Linden,** Palisades Park, N. J., assigned to **The Linde Air Products Co.** Filed Oct. 1, 1940. Issued June 22, 1943.



A cluster-type, multi-flame oxy-acetylene torch tip for the manual welding of ferrous metal parts on which surfaces must be preheated. The tubular unitary metal body member has at its forward end a welding-flame face, a root-flame face and a preheating-flame face. Welding-flame face lies in a plane substantially normal to the longitudinal axis of the body member; root-flame face is adjacent to welding-flame face and between it and the preheating-flame face. The three faces lie in planes inclined with respect to one another.

Body member has a combustible gas inlet chamber extending axially through the major portion of its length and terminating in spaced relation to the forward end of the member. A single gas outlet passage extends substantially axially and forward from the inlet chamber to the welding-flame face for discharging a single main welding jet. A pair of gas outlet orifices extends from the forward end of the inlet chamber for discharging a pair of preheating jets; these orifices extend in divergent angular relation to the passage. A single gas outlet port extends from the forward end of the inlet chamber to the root-flame face for discharging a preheating jet. Orifices and port extend in angular relation on the same side of the axis of passage, the arrangement being such that when the tip is about ½ in. from the parts being welded the extremities of the pair of preheating jets impinge against the sides of the groove at a distance of approximately one inch from the point of impingement of the main welding jet.

» «



Flame-Cutting Machine

2,321,949. **Andrew Ralph Sorensen,** San Francisco, Calif. Filed April 20, 1942. Issued June 15, 1943.

This cutting apparatus consists of a cutting torch, an arm, a fixed pivot for the arm, a second arm pivotally connected to the first, a plate hingeably connected to the second arm, and a means for mounting the torch on the plate.

EZY-FLEX WELDING CABLE

A TOUGH WEAR RESISTING CABLE

MEETING ALL WAR PRODUCTION BOARD REGULATIONS

15 MILLION FEET SOLD LAST YEAR!

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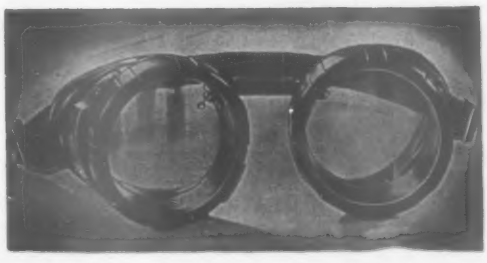

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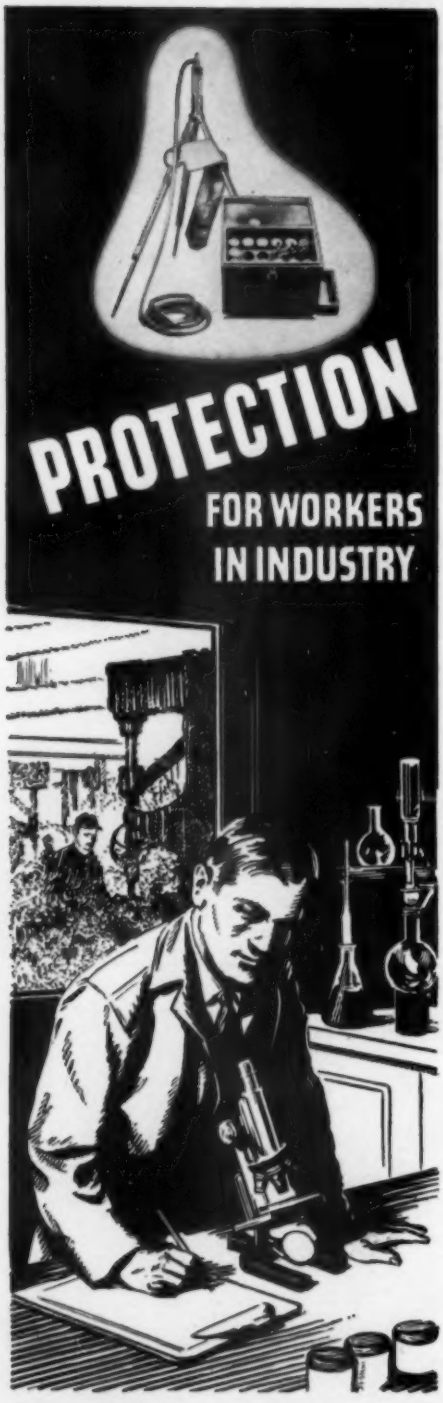

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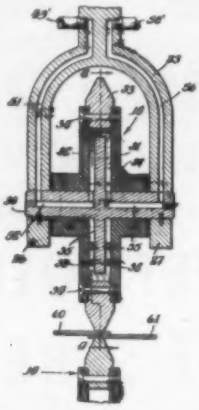
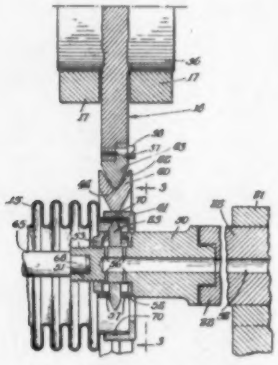
Seam Welder

2,322,796. **David Wendell Fentress,** Evanston, Ill., assigned to **Chicago Metal Hose Corp.,** Maywood, Ill. Filed April 28, 1941. Issued June 29, 1943.



A seam welding apparatus having two electrode wheels which rotate on a horizontal axis. The rotatable bearing surfaces are non-conductive. An electrically conductive non-rotatable bearing surface is mounted on the support structure.

» «



Tube Welding Apparatus

2,323,903. **David Wendell Fentress,** Evanston, Ill., assigned to **Chicago Metal Hose Corp.,** Maywood, Ill. Filed Dec. 24, 1941. Issued July 13, 1943.

An apparatus for seam welding tubing and other circular work pieces. An inner rotatable electrode is adapted to be arranged within the tubing, while an outer ringlike electrode is arranged externally to embrace the tubing. After the electrodes have been brought into electrical contact with the work, they are rotated while an electric current is passed between them to effect the welding operation.

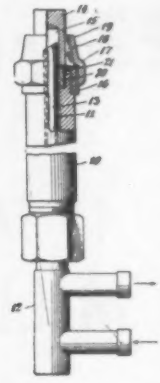
» «

Flash Welding Method

2,323,660. **Edman Francis Holt,** Indianapolis, assigned to **P. R. Mallory & Co., Inc.,** Indianapolis. Filed March 7, 1942. Issued July 6, 1943.

A method of welding dissimilar metals, one of which has a higher melting point than the other. Current is passed in a D-C circuit from the higher melting point metal to the other metal, creating an arc between them and thereby heating them to welding temperature. The metals are heated unequally, the higher melting point metal being raised to the higher temperature. When welding temperature is reached, the metals are pressed into contact to complete the weld.

» «

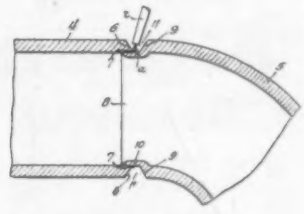


Spot Welding Electrode Holder

2,322,691. **Franz R. Hensel,** Indianapolis, assigned to **P. R. Mallory & Co., Inc.,** Indianapolis. Filed Aug. 4, 1942. Issued June 22, 1943.

A spot welding electrode holder having a longitudinal fluid passage emerging at one end. A sharp annular ridge surrounds this passage, and a clamp holds a welding electrode against the ridge in such a manner that the ridge will make electric contact and form a water seal with the electrode.

» «



Welding Fitting

2,324,335. **Edward Hall Taylor,** Chicago. Filed Dec. 20, 1940. Issued July 13, 1943.

A tubular pipe fitting with an annular end surface adapted to be joined by welding to the end of a conventional pipe. The end of the fitting is provided with an annular lip which is offset inwardly a distance equal to the wall thickness. This is adapted for insertion into the pipe end, while remaining free therefrom to allow independent expansion and contraction. At about its midlength, the lip has an exterior circumferential bead of relatively slight mass; this and the outer end of the lip coöperate with the pipe end to position the fitting relative to the pipe. The spacing is such that the distance from the inner edge of the fitting to the pipe end is materially greater than the thickness of the bead, thereby providing a wide-bottomed trough between the welding surfaces of the pipe end and the fitting. There is also provided a dam to prevent the flow of molten metal into the interior of the joined fitting and pipe end.

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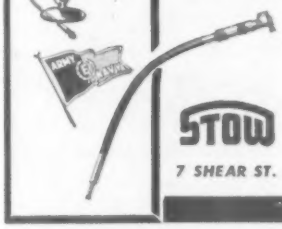

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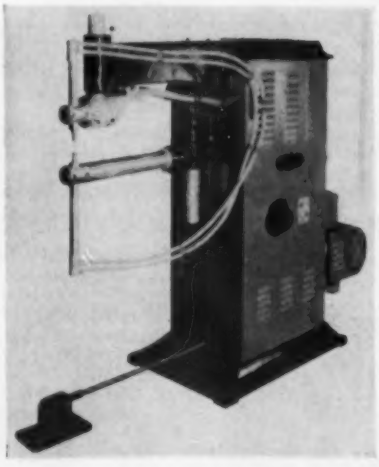

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Write for Spot Welder Bulletin

UNIVERSAL POWER CORP.
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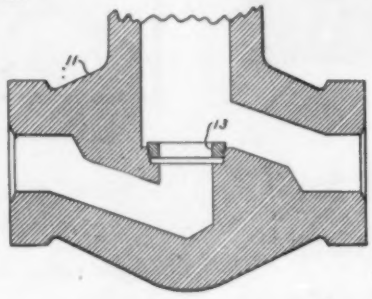
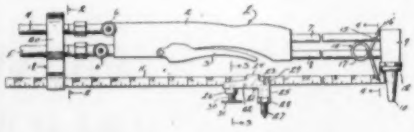
Hard-Facing Bond

2,322,507. **Norman W. Cole,** Detroit. Filed May 15, 1940. Issued June 22, 1943.



A method of bonding a preformed metallic element of hard-facing alloy to a preformed base member of iron or steel. Alloy consists of a nickel base with chromium and boron as the other main constituents; the nickel base ranges from 63% to 73%, the chromium from 15% to 22%, the boron from 3% to 5%, and carbon, iron and silicon total not over 10%. The preformed element made of this alloy is aligned with the base member and the assembly heated in a non-oxidizing atmosphere to a temperature of from 1,850 F to 2,200 F. Heating is carried on until the hard metal component having the lowest melting point has alloyed with the surface of the base metal, and the hard metal casting has settled by its own weight to the finally desired position.

» «

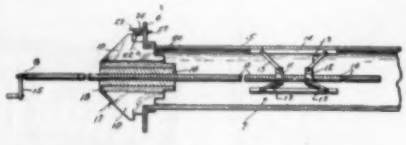


Cutting Torch Radius Rod

2,323,298. **James L. Cook,** Trinity Center, Calif. Filed Feb. 26, 1942. Issued July 6, 1943.

An attachment for a cutting torch comprising a calibrated bar holding the cutting tip at one end; this bar is maintained parallel to the torch body. A centering unit is slidably mounted upon the bar and carries a pointed pivot. The bar is thus adjustable for making circular cuts of any desired radius.

» «



Pipe Welding Clamp

2,323,039. **Frank Hill,** Borger, Tex. Filed June 21, 1941. Issued June 29, 1943.

An expansible and contractible clamp for holding a pipe flange in proper alignment with the pipe to which it is to be welded. The clamp embodies an adjusting screw, a bearing through which screw is trained and a flange holder sleeved on the bearing and adapted to be inserted through the opening in the flange, which is clamped between the adjacent end of the pipe and adjacent portions of the flange holder. The latter has a stepped surface to accommodate flanges from a relatively small to a relatively large diameter.

» «

Cast Iron Electrode

2,323,711. **Raymond J. Franklin,** Chicago, assigned to **Chicago Hardware Foundry Co.,** North Chicago, Ill., Filed July 20, 1942. Issued July 6, 1943.

A coated electrode for welding cast iron. Core is predominantly of iron with a 1.85% carbon content. Composition of the coating includes 10% to 40% carbon, 7½% to 30% phosphorus, 10% to 60% slag-forming material and a binder.

» «

Flame-Hardening Apparatus

2,321,645 **James O. Bishop,** Torrance, and **Lloyd L. Babcock,** Compton, Calif., assigned to **The National Supply Co.,** Pittsburgh, Pa. Filed August 3, 1940. Issued June 15, 1943.

A device for flame-hardening gear teeth. The torch is positioned adjacent the flank of a tooth, extending along the flank for substantially the full length thereof; the flame is directed at right angles against the entire flank surface that is to be hardened. An oscillatory movement, both laterally and longitudinally of the flank surface, may be imparted to the torch.

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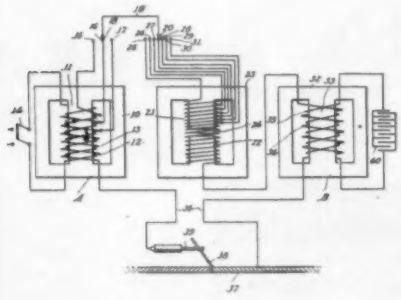
Recording Timer

2,322,052. **Jack Ogden, Huntington Woods** and **Harold B. Wilkins,** Detroit, assigned to **General Motors Corp.,** Detroit. Filed Sept. 21, 1940. Issued June 15, 1943.

A recording device for measuring the time periods of a spot welding cycle. Elements are: a voltage input connected to the transformer primary, a control switch in the input circuit, a resistance connected across the control switch, a pair of control transformers, a plurality of lines connecting the primaries of these transformers to various locations in the secondary welding circuit, a plate, a sensitive strip, means for continuously feeding the strip over the plate, a plurality of electrodes adjacent the strip on the opposite side from the plate, lines separately connecting one extremity of the resistance and each of the pair of transformer secondaries to one of the electrodes, and a common line connected to the plate, the opposite side of the resistance and the opposite secondary connection on the pair of transformers. Voltages developed will cause a discharge to the plate, making a record on the sensitive paper being fed over it.



A-C Welder

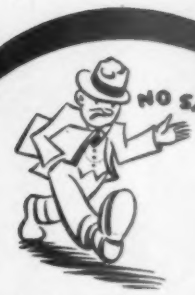
2,322,709. **Frederick C. Owen,** Fayetteville, N. C. Filed Jan. 13, 1939. Issued June 22, 1943.

A-C welding apparatus comprising a main transformer and an auxiliary transformer, each of which has a core providing a closed magnetic circuit and closely coupled primary and secondary windings thereon. A capacitance is connected across the secondary of the auxiliary transformer. There is also a reactor having a core providing a closed magnetic circuit interrupted with an air gap; a winding mounted on the core bridges the air gap. The secondary of the main transformer, the winding of the reactor and the primary of the auxiliary transformer are connected in series.

Light Metal Flux

2,322,416. **John D. Coleman** and **Charles W. Ewing,** Dayton, O., assigned to **General Motors Corp.** Filed June 17, 1940. Issued June 22, 1943.

A flux produced by (1) mixing boric acid and a normal fluoride of a metal selected from the group consisting of lithium, sodium, potassium, magnesium, strontium and calcium and (2) mixing the resultant product with hydrogen fluoride.



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Energy Storage Welding System

2,319,215. **John W. Dawson,** Auburndale, Mass., assigned to **Raytheon Mfg. Co.,** Newton, Mass. Filed Aug. 15, 1941. Issued May 18, 1943.

A welding system comprising an electrical energy storage device, means for supplying energy, a welding load circuit, an additional source of electrical current, means for discharging the stored energy and a contactor. Operating after a predetermined period of delay after discharge of the stored energy, the contactor connects the additional source of current to the load circuit in such closely timed sequence as to produce a unitary welding action.

» «

Stud Welding Gun

22,317 (reissue of No. 2,287,818). **Edward F. Nelson,** Vallejo, Calif. Application for reissue filed June 30, 1942. Issued May 18, 1943.

A welding apparatus for welding a stud to a plate through an apertured covering. Covered are a welding head including means for holding the stud, a support releasably connected to the welding head and including a hand grip and also a foot on which the apparatus rests upon the covering, and manually operable release means adjacent the hand grip for adapting the welding head and the support to correct their relative positions under the pull of gravity when the stud and the support are placed on the plate and covering.

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Spot Welding Circuit

2,319,763. **Stanley M. Humphrey,** Warren, O., assigned to **The Taylor-Winfield Corp.,** Warren. Filed Sept. 3, 1941. Issued May 18, 1943.

Circuit for supplying unidirectional current of high amplitude and short duration to a low impedance load. Combination comprises a large capacitor, a charging circuit including a rectifier, a discharging circuit interconnecting capacitor and load, a discharge device in parallel with capacitor and having a control element adapted to be connected with the rectifier. The discharge device is rendered conductive upon the reversal of polarity on the capacitor, as detected by conduction through the rectifier.

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Tube Welding Process

2,322,671. **Sigfrid W. Specht,** Youngstown, O., assigned to **The Youngstown Sheet and Tube Co.,** Youngstown, O. Filed Aug. 29, 1941. Issued June 22, 1943.

A method of making metal tube having a diameter of about 1½ in. or less and a wall thickness of about 0.125 in. or less. The steps include: (1) longitudinally advancing hot-rolled strip of suitable width and thickness having an adherent coating of oxide thereon, (2) progressively heating the strip throughout its width to softening temperature, (3) progressively forming the strip into a cylindrical blank with a longitudinal seam cleft, (4) quenching the strip, thereby fragmenting and detaching the oxide coating from the surface area of the strip, (5) trimming and brushing the edges of the seam cleft and (6) uniting them by means of progressive resistance welding.

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